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RG 15

File 7

Object Correspondence File
1930-1945

Box 410

"222 Colorado River Imperial Valley
Irrigation Districts
Imperial Irrigation District
John December 31, 1930"

UNITED STATES
DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

TRANS. 111-11111
4781-
COLORADO RIVER
IMPERIAL VAL.

Sept. 10, 1930

File

201 Post Office Bldg.,
Berkeley, California,
October 8th, 1930.

From District Counsel Richard J. Coffey

To Commissioner (in duplicate)

Subject Agreement with Imperial Irrigation District covering the construction of All American Canal.

1. We have prepared and enclose, in duplicate, copy of preliminary draft of contract covering the construction of the All American Canal and appurtenant structures, which is intended to serve as the basis for discussions to be had with representatives of the Imperial and Coachella Valley interests. It is proposed that the Imperial Irrigation District extend its boundaries to include all lands now included in the Coachella Valley County Water District, which accounts for the latter district not being mentioned in the draft of agreement herewith.

2. I had intended to discuss the matter with Mr. Childers, attorney for the Imperial Irrigation District, and with Mr. Yeager, attorney for the Coachella Valley County Water District, prior to putting the draft in form for submission to you, but this has had to be postponed for a few days because of Mr. Childers being tied up with litigation in the southern part of the state. I expect, however, to have a preliminary discussion of the draft with these gentlemen in a few days.

3. A number of questions have arisen in the preparation of the draft of agreement herewith, which I desire to discuss with Mr. Dent before we take the matter up with the Imperial Irrigation District, the most important of which are the quantity of water which the District gets, which will have to be stated in Article fifteen of the agreement, and the extent to which the agreement of October 23, 1918, should be amended. As I understand the situation with regard to the participation of the Yuma project in the possible development of power on the canal, the Water Users' Association desires to participate in some fashion, but does not desire to become obligated in this connection. As a means of getting started on this phase of the situation article fourteen of the draft of contract herewith has been prepared. I have no idea, however, that it will serve any greater purpose than opening the subject for discussion.

4. In the preliminary discussion which Mr. Walter, Mr. Gault and I had with representatives of the Coachella and Imperial Valleys, and with representatives of the City and County of San Diego, it developed that San Diego is anxious to obtain a supply of water from the Colorado River, and to utilize the All American Canal for the transportation of such water to

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some convenient point in the Imperial Valley. As I construe the Boulder Canyon Project Act we are not authorized to provide capacity in the proposed All American Canal for interests outside of the Imperial and Coachella Valleys with interest free money, but that such capacity could be provided under the provisions of that part of the act of March 4, 1921 (41 Stat., 1367, 1404), reading:

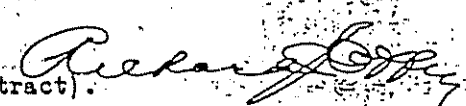
"All moneys hereafter received from any State, municipality, corporation, association, firm, district, or individual for investigations, surveys, construction work, or any other development work incident thereto involving operations similar to those provided for by the reclamation law shall be covered into the reclamation fund and shall be available for expenditure for the purposes for which contributed in like manner as if said sums had been specifically appropriated for said purposes;"

if funds for the purpose were advanced to us. There were indications that such an arrangement would be agreeable to San Diego, but the Imperial Irrigation District representatives announced that such a plan would not meet with their approval. Regardless of this fact, however, I have so prepared the agreement herewith that we can provide extra capacity in the canal for interests outside the Coachella and Imperial Valleys. It seems to me that we will have to reserve such right to the United States or else place ourselves in the position of preventing urban districts along the coast from getting water through the Imperial Valley. The Metropolitan Water District of Southern California has not as yet definitely decided upon the location of its aqueduct, as I understand it, and one of their possible routes is along the location of the All American Canal. If by any chance we don't reserve the right to let others use the All American Canal, and the Metropolitan District should later conclude to use that route, it is not inconceivable that we would be placed in the position of having precluded them from doing so.

5. Another point that has occurred to me is the use which the Imperial Irrigation District can make of the All American Canal for the development of power. The act directs that no charge be made for water for potable and irrigation purposes within the Coachella and Imperial Valleys, and it is my opinion that we are not authorized to furnish them with free water for the development of power only, and that if the District desires to divert water for power purposes, later dumping such water back into the Colorado River, a charge of twenty-five cents per acre foot will have to be made for such privilege.

6. I would suggest as a good plan that after consideration of the foregoing matters in Washington, that Mr. Dent stop off at Denver on his trip here in connection with the negotiation of the contract, and discuss the contract with the Chief Engineer's office.

cc - Chief Engineer (with copy of draft of contract).



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

DOUGLAS CANYON PROJECT

CONTRACT BETWEEN THE UNITED STATES OF AMERICA AND THE IMPERIAL IRRIGATION DISTRICT, PROVIDING FOR CONSTRUCTION OF DIVERSION DAM, MAIN CANAL AND APPURTENANT STRUCTURES AND FOR DELIVERY OF WATER.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

BOULDER CANYON PROJECT

Contract for Construction of Diversion Dam, Main Canal and Appurtenant
Structures and for Delivery of Water

(1) THIS CONTRACT, made this day of
nineteen hundred thirty, pursuant to the Act of Congress approved June
17, 1922 (42 Stat., 503), and acts amendatory thereof or supplementary
thereto, all of which acts are commonly known and referred to as the
reclamation law, and particularly pursuant to the Act of Congress ap-
proved December 21, 1928 (45 Stat., 1037), designated the Boulder Canyon
Project Act, between THE UNITED STATES OF AMERICA, hereinafter referred
to as the United States, acting for this purpose by Ray Lyman Wilbur,
Secretary of the Interior, hereinafter styled the Secretary, and the
IMPERIAL IRRIGATION DISTRICT, an irrigation district created, organized
and existing under and by virtue of the laws of the State of California,
with its principal place of business at El Centro, Imperial County,
California, hereinafter referred to as the District;

WITNESSETH:

Explanatory Recitals

(2) WHEREAS, for the purpose of controlling the floods, improving
navigation and regulating the flow of the Colorado River, providing for
storage and for the delivery of the stored waters for reclamation of public
lands and other beneficial uses exclusively within the United States, the
Secretary, subject to the terms of the Colorado River Compact, is authorized

of, or resulting from the construction of said diversion dam, main canal and appurtenant structures, including the cost of labor, materials, equipment, engineering, legal work, superintendence, administration, overhead, damage of all kinds and character and rights-of-way as hereinafter provided; excepting any and all claims due to construction and operation of the diversion dam as to which the District hereby agrees to save the United States harmless. The United States will invoke all legal and valid reservations of rights-of-way under acts of Congress or otherwise reserved or held by it, without cost to the District, except that the United States reserves the right where rights-of-way are thus acquired to reimburse the owners of such lands for the value of improvements which may be destroyed, and the District agrees that the United States may include such disbursements in the cost of the work to be performed hereunder. If rights-of-way are required over an existing project of the Bureau of Reclamation, such sum or sums as may be necessary to reimburse the United States on account of the unpaid and unaccrued construction charges allocated to irrigable areas absorbed in such rights-of-way shall also be considered as a part of and be included with other costs of the work to be performed hereunder. The District agrees to convey to the United States without cost, unencumbered fee simple title to any and all lands now owned or hereafter acquired by it, which, in the opinion of the Secretary, may be required for right-of-way purposes for the aforesaid diversion dam, main canal and appurtenant structures. Where rights-of-way are required for the construction of works herein provided for, and such rights-of-way are not reserved to the United States under acts of Congress, or otherwise, or the lands over which such rights-of-way are required are not then owned by the District, the District agrees that it will, upon demand of the Secretary, acquire title

to such lands, and in turn convey unencumbered fee simple title thereto to the United States for the reasonable value thereof, as determined by the Secretary.

Assumption of Operation and Maintenance by District

(6) Within sixty (60) days after the completion of construction of the aforesaid diversion dam, main canal and appurtenant structures, or of any major unit thereof, as determined by the Secretary, whose determination thereof shall be final and binding upon the parties hereto, the United States may give written notice to the District of such completion, together with an itemized statement of the cost thereof. In the event of termination of work as herein elsewhere provided, a similar notice and statement shall be furnished the District within sixty (60) days thereafter. Upon receipt of either such notice, the District shall assume the care, operation and maintenance of said diversion dam, main canal and appurtenant works, and thereafter the District shall at its own cost and without expense to the United States care for, operate and maintain the same in such manner that such works shall remain in as good and efficient condition and of equal capacity for the development, diversion, transportation and distribution of water as when received from the United States, reasonable wear and damage by the elements excepted. After the care, operation and maintenance of the aforesaid works has been assumed by the District, the District shall save the United States, its officers, agents and employees harmless as to any and all injury and damage to persons and property which may arise out of the care, operation and maintenance thereof.

Keeping Diversion Dam, Main Canal and Appurtenant Structures in Repair

(9) Except in case of emergency no substantial change in any of the works to be constructed by the United States and transferred to the District under the provisions hereof shall be made by the District without first having had and obtained the written consent of the Secretary, and the Secretary's opinion as to whether any change in any such works is or is not substantial shall be conclusive and binding upon the parties hereto. The District shall promptly make any and all repairs to and replacements of all works transferred to it under the terms and conditions hereof, which, in the opinion of the Secretary, are deemed necessary for the proper operation and maintenance of such works. In case of neglect or failure of the District to make such repairs, the United States may, at its option, cause such repairs to be made and charge the actual cost thereof, plus fifteen per centum (15%) to cover overhead and general expense, to the District. The cost to the United States, plus overhead and general expense as stated above, of making any of the repairs contemplated by this contract, shall be repaid by the District on June first immediately succeeding the date of completion of such repairs.

Agreement by District to Pay for Works Constructed by the United States

(10) The District agrees to pay the United States the aforesaid sum of thirty-eight million five hundred thousand dollars (\$38,500,000.00) for work herein provided for, including all costs and expenses in connection therewith, as specified; provided, that if on account of the omission of Congress to make adequate appropriations, or for other reasons, the full amount stated shall not be expended by the United States on such work, then and in that event the amount to be paid by the District to the United States shall be reduced to the amount actually expended as shown by the

statement to be furnished the District under the provisions of Article eight (8) hereof.

Terms of Payment

(11) The amount herein agreed to be paid to the United States shall be due and payable in forty (40) equal annual installments commencing with the calendar year next succeeding the year when notice of completion of the work provided for herein is given to the District as provided in Article eight (8), or commencing with the calendar year next succeeding the termination of work under the provisions of Article thirty-one (31), as the case may be. The sums payable annually as set forth above shall be again divided into two (2) equal payments, payable on June 1st and December 1st of each year.

Power Possibilities

(12) The District or other agencies mentioned in article twenty-one (21) hereof shall have the privilege at any time of utilizing by contract or otherwise such power possibilities as may exist upon said canal, in proportion to their respective contributions or obligations toward the capital cost of said canal and appurtenant structures from and including the diversion works to the point where each respective power plant may be located. The net proceeds from any power development on said canal shall be paid into the Colorado River Dam Fund and credited to the District or other agencies on their said contracts, in proportion to their rights to develop power, until the District or other agencies using said canal shall have paid thereby and under any contract or otherwise an amount of money equivalent to the operation and maintenance expense and cost of construction thereof. Thereafter such proceeds shall be paid to the District or other agencies. It is understood and agreed, however, that the provisions of

this article shall not be held to apply to power developed at Syphon Drop with water diverted, transported and delivered for the use and benefit of the Yuma Project as herein elsewhere provided.

Diversion and Delivery of Water for Yuma Project

(15) It is understood by the District that the construction of the aforesaid diversion dam, main canal and appurtenant structures will interfere with the operation and maintenance of existing facilities of the United States down to an including Syphon Drop provided for the diversion and transportation of water for that certain irrigation project of the United States known as and designated the Yuma project, situate primarily in the State of Arizona, but situate also as to a part or portion thereof in the State of California, and in consideration of the execution hereof and the construction of the works provided for herein, the District hereby agrees to divert at the diversion dam to be constructed hereunder, and to transport and deliver at Syphon Drop Power Plant and/or such intermediate points as may be designated by the Secretary, two thousand (2,000) second-feet of water, or such part thereof as the Yuma project may be entitled to, for the use and benefit of said Yuma project, including the development of power at Syphon Drop, such water to be diverted, transported and delivered continuously as far as reasonable diligence will permit; provided, however, that water shall not be diverted, transported or delivered for the Yuma project when the Secretary notifies the District that said project for any reason may not be entitled thereto. The diversion, transportation and delivery of water for the Yuma project as aforesaid shall be without expense to the United States, or its successors in control of said project, as to capital investment required to provide facilities for such diversion and transportation of water. The cost of operation and maintenance for

the diversion dam and main canal down to Syphon Drop and of Laguna Dam shall be prorated in proportion to the amounts of water carried for the District and the Yuma Project.

Delivery of Power to Yuma Project

(14) The contract of October 23, 1918, between the United States and the Imperial Irrigation District, providing for a connection with the Laguna Dam, is hereby modified to the extent that in lieu of the provisions thereof for participation of said Yuma project in the development of power down to and including some convenient power site near Pilot Knob, the District hereby agrees to deliver to the United States, or its successors in interest in control of said Yuma project, if power is developed on said main canal by the District directly or under contract, such amount of electrical energy, not, however, exceeding eight thousand five hundred horsepower, as may be used for project purposes, said energy to be delivered at cost to the District as determined by the Secretary.

Delivery of Water by United States

(15) The United States shall, upon completion of Hoover Dam, deliver to the District from Boulder Canyon Reservoir at a point in the Colorado River immediately below said Hoover Dam, up to but not to exceed
..... (.....) acre-foot of water per year, which shall be delivered continuously as far as reasonable diligence will permit; provided, however, that the quantity of water to be furnished hereunder shall not under any circumstances exceed the quantity which may be reasonably required for potable purposes within the District and/or applied beneficially in accordance with good usage in the irrigation of lands within the District; and provided further, that this contract is without prejudice to any rights which the District may now have or hereafter acquire in or to the waters

of the Colorado River. The United States shall not be obligated to deliver water to the District when for any reason such delivery would interfere with the use of Hoover Dam and Boulder Canyon Reservoir for river regulation, improvement of navigation, flood control, and/or satisfaction of present perfected rights, in or to the waters of the Colorado River, or its tributaries, in pursuance of Article VIII of the Colorado River Compact, and this contract is made upon the express condition and with the express covenant that the right of the District to waters of the Colorado River, or its tributaries, is subject to and controlled by the Colorado River Compact. The United States reserves the right to discontinue or temporarily reduce the amount of water to be delivered for the purposes of investigation, inspection, maintenance, repairs, replacement or installation of equipment and/or machinery at Hoover Dam, but as far as feasible the United States will give the District reasonable notice in advance of such temporary discontinuance or reduction. The United States, its officers, agents and employees shall not be liable for damages when, for any reason whatsoever, suspensions or reductions in delivery of water occur. This provision for the delivery of water to the District is for permanent service, but no charge shall be made for the use, storage or delivery of such water.

Measurement of Water

(16) The water to be delivered hereunder shall be measured at the intake of the main canal to be constructed by the United States under the terms and conditions hereof by measuring and controlling devices satisfactory to the Secretary. Said measuring and controlling devices shall be furnished, installed and maintained by and at the expense of the District, but they shall be and remain at all times under the complete control

of the United States, whose authorized representatives may at all times have access to them over the lands and rights-of-way of the District.

Receipt of Water by District

(17) The District shall receive the water to be delivered to it by the United States under the terms hereof at the point of delivery above stated and shall at its own expense convey such water to the diversion due to be constructed under the terms and conditions hereof, and shall perform all acts required by law or custom in order to maintain its control over such water and to secure and maintain its lawful and proper diversion from the Colorado River.

Record of Water Diverted

(18) The District shall make full and complete written monthly reports as directed by the Secretary, on forms to be supplied by the United States, of all water diverted from the Colorado River. Such reports shall be made by the fifth day of the month immediately succeeding the month in which the water is diverted, and the records and data from which such reports are made shall be accessible to the United States on demand of the Secretary.

Refusal of Water in Case of Default

(19) The United States reserves the right to refuse to deliver water to the District in the event of default for a period of more than twelve (12) months in any payment due or to become due the United States under this contract, it being understood, however, that the provisions of this article shall not relieve the District of its obligation to divert, transport and deliver water for the use and benefit of the Tuxa project as herein elsewhere provided, nor shall it relieve the District of its obligation hereunder to divert, transport and deliver water for

the use and benefit of other agencies with whom the United States may contract for the diversion, transportation and delivery of water through or by the works to be constructed under the terms hereof. The United States further reserves the right to forthwith assume control of the works to be constructed hereunder and to care for, operate and maintain the same, if, in the opinion of the Secretary, whose opinion shall be final and binding upon the parties hereto, the District does not carry out the terms and conditions of this contract to their full extent and meaning. In such event, the District's pro rata share of the cost of such care, operation and maintenance by the United States shall be repaid to the United States, plus fifteen per centum (15%) to cover overhead and general expense, on June first of each year immediately succeeding the calendar year during which the works to be constructed hereunder are operated and maintained by the United States.

Use of works by the United States and Others

(20) The District agrees that it will, upon request of the Secretary, take immediate and necessary action to have included in the District such irrigable public lands of the United States within the Imperial and Coachella Valleys as may be designated by the Secretary. In the event of failure of the District so to include such public lands within the District within a reasonable time the United States reserves the right to and the District agrees that the United States may use the aforesaid diversion dam, main canal and appurtenant structures, or such part thereof as may be necessary therefor, as determined by the Secretary, for the purpose of diverting, transporting and delivering water for use on said lands; provided, however, such public lands shall in such event bear their proportionate part of the cost of construction and of operation and

maintenance charges of that part of the said works as may be determined as equitable by the Secretary, whose determination thereof shall be final and binding upon the parties. The United States also reserves the right to, and the District agrees that it may contract with other agencies for the use of the aforesaid works, and that the United States may at any time increase the capacity of the said works for such purpose. In the event other agencies thus contract with the United States, the District shall be released from its obligations hereunder to the extent that the capacity of that part of said works thus provided for such other agencies bears to the total capacity of such works. Such other agencies shall also bear such proportionate part of the cost of operation and maintenance as the capacity of that part of such works provided for their use and benefit bears to the total capacity of said works.

Title to Remain in United States

(21) Title to the aforesaid diversion dam, main canal and appurtenant structures to be constructed by the United States under the terms and conditions hereof, shall be and remain in the United States notwithstanding transfer of the care, operation and maintenance thereof to the District; provided, however, that the Secretary may, in his discretion, when repayments to the United States of all money advanced shall have been made, transfer the title to said main canal and appurtenant structures, except the diversion dam and the main canal and appurtenant structures down to and including Hyphen Drop, to the District or other agencies of the United States having a beneficial interest therein in proportion to their respective capital investments under such form of organization as may be acceptable to him.

Taxation of Government Land

(20) All unentered public lands and entered lands for which no final certificate has been issued, now situate within the district (or hereafter annexed to the district, upon the Secretary's consenting, in the case of land hereafter annexed to the district, to the taxation hereunder of such added lands, which consent will be manifested by a letter filed with the District, a copy of such letter to be filed also with the General Land Office and a copy with the Local Land Office at Los Angeles, California), and described, so far as concerns lands now located within the district, in a statement marked Exhibit "B" attached hereto and by this reference made a part hereof, are hereby designated as subject to the provisions of the Act of August 11, 1916 (39 Stat., 806), and the Act of May 16, 1923 (42 Stat., 541). Vacant public lands, however, now in the district or hereafter added to the district, are not to be subject to assessment while in that status.

Rules and Regulations

(21) There is reserved to the Secretary the right to prescribe and enforce rules and regulations governing the delivery and diversion of water hereunder. Such rules and regulations may be modified, revised and/or extended from time to time after notice to the District and opportunity for it to be heard, as may be deemed proper, necessary, or desirable by the Secretary to carry out the true intent and meaning of the law and of this contract, or amendments thereof, or to protect the interests of the United States. The District hereby agrees that in the operation and maintenance of the diversion dam and main canal and appurtenant structures provided for herein, all such rules and regulations will be fully adhered to.

Inspection by the United States

(24) The Secretary may cause to be made from time to time a reasonable inspection of the works constructed by the United States under the terms hereof to the end that he may ascertain whether the terms of this contract are being satisfactorily executed by the District. The actual expenses of such inspection in any one calendar year, as found by the Secretary, whose determination thereof shall be final and conclusive and binding upon the parties hereto, shall be paid by the District to the United States on June first of each year, immediately following the year in which such inspection is made. The Secretary or his representatives shall at all times have the right of ingress to and egress from all works of the District for the purposes of inspection, repairs and maintenance of works of the United States, and for all other proper purposes. The Secretary or his representatives shall also have free access at all reasonable times to the books and records of the District relating to the diversion and distribution of water delivered to it hereunder with the right at any time during office hours to make copies of or from the same.

Disputes or Disagreements

(25) Disputes or disagreements as to the interpretation or performance of the provisions of this contract shall be determined either by arbitration or court proceedings, the Secretary being authorized to act for the United States in such proceedings. Whenever a controversy arises out of this contract, and the parties hereto agree to submit the matter to arbitration, the District shall name one arbitrator and the Secretary shall name one arbitrator, and the two arbitrators thus chosen shall elect three other arbitrators, but in the event of their failure to name all or any of the three arbitrators within five (5) days after their first meeting, such

arbitrators, not so elected, shall be named by the Senior Judge of the United States Circuit Court of Appeals for the Ninth Circuit. The decision of any three of such arbitrators shall be a valid and binding award of the arbitrators.

charged a General obligation of the District

(20) The District as a whole is obligated to pay to the United States the full amount herein agreed upon regardless of the default or failure of any tract in the District, or of any landowner in the District, in the payment of the assessments levied by the District against such tract or landowner, and the District shall levy and collect such assessments whenever necessary to make up for the default or delinquency of any tract of land or of any landowner in the payment of assessments, so that in any event, and regardless of any default or delinquency in the payment of any assessment or assessments, the amounts due or to become due the United States shall be paid to the United States by the District when due. After the date of this contract no change shall be made in the boundaries of the district, and the Board of Directors shall make no order changing the boundaries of the district unless and until the Secretary shall assent to such change in writing, and such assent shall have been filed with the Board of Directors of the District.

Interest and Penalties

(21) No interest shall be charged on deferred installments of charges due from the District hereunder, but on all such installments or any part thereof, that may remain unpaid by the District to the United States after the same become due, there shall be added to the amount unpaid a penalty of one per centum (1%), and a like penalty of one per centum (1%)

of the amount unpaid shall be added on the first day of each month thereafter so long as such default shall continue.

Agreement Subject to Colorado River Compact

(20) This contract is made upon the express condition and with the express understanding that all rights hereunder shall be subject to and controlled by the Colorado River Compact, being the compact or agreement signed at Santa Fe, New Mexico, November 24, 1922, pursuant to Act of Congress approved August 19, 1921, entitled "An Act to permit a compact or agreement between the States of Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming, respecting the disposition and apportionment of the waters of the Colorado River, and for other purposes", which Compact was approved in Section 13 (a) of the Boulder Canyon Project Act.

Contract to be Authorized by Election and Confirmed by Court

(21) The execution of this contract by the District shall be authorized by the qualified electors of the District at an election held for that purpose. Thereafter, without delay, the District shall prosecute to decree proceedings in court for a judicial confirmation of the authorization and validity of this contract. The United States shall not be in any manner bound under the terms and conditions of this contract unless and until a confirmatory final judgment in such proceedings shall have been rendered, including final decision, or pending appellate action if ground for appeal be laid. The District shall without delay and at its own cost and expense furnish the United States for its files, copies of all proceedings relating to the election upon this contract and the confirmation proceedings in connection therewith, which said copies shall be properly certified by the Clerk of the court in which confirmatory decree is obtained.

Contract Does Not Affect Certain Other Contract

(30) Except as expressly modified hereby, nothing in this contract shall be construed as modifying in any manner the existing contract, dated October 23, 1918, between the United States and the Imperial Irrigation District, providing for a connection with Laguna Dam.

Contingent Upon Appropriations

(31) This contract is subject to appropriations being made by Congress from year to year of moneys sufficient to do the work provided for herein, and to there being sufficient moneys available in the Colorado River Dam Fund to permit allotments to be made for the performance of such work. No liability shall accrue against the United States, its officers, agents, or employees, by reason of sufficient moneys not being so appropriated nor on account of there not being sufficient moneys in the Colorado River Dam Fund to permit of said allotments. Should more than two years elapse at any time after this contract becomes effective and before the work provided for herein is completed, without any appropriation therefor being made by Congress, the work provided for hereby may be terminated by either party hereto by giving the other party sixty (60) days' written notice of its intention so to do. If more than three years elapse after this contract becomes effective and before appropriations are available to permit the United States to make expenditures hereunder, the District may, at its option, upon giving sixty (60) days' written notice to the Secretary, cancel this contract.

Priority of Claims of the United States

(32) Claims of the United States arising out of this contract shall have priority over all others, secured and unsecured, and the District shall exercise all its powers including the power of taxation, and the

powers of assessment, levying and collection of taxes of every kind, which the District now has or may hereafter acquire, for the provision of funds which may become due to the United States under this contract.

Rights Reserved under Section 5787 Revised Statutes

(53) All rights of action for breach of any of the provisions of this contract are reserved to the United States as provided in Section 5787 of the Revised Statutes of the United States.

Remedy under Contract not Exclusive

(54) Nothing contained in this contract shall be construed as in any manner abridging, limiting or depriving the United States of any means of enforcing any remedy either at law or in equity for the breach of any of the provisions hereof which it would otherwise have. The waiver of a breach of any of the provisions of this contract shall not be deemed to be a waiver of any other provision hereof or of a subsequent breach of such provision.

Interest in Contract not Transferable

(55) No interest in this contract is transferable by the District to any other party, and any such attempted transfer shall cause this contract to become subject to annulment at the option of the United States.

(56) Member of Congress Clause

(56) No Member of or Delegate to Congress or Resident Commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom. Nothing, however, herein contained shall be construed to extend to this contract if made with a corporation for its general benefit.

IN WITNESS WHEREOF, the parties hereto have caused this
contract to be executed the day and year first above written.

THE UNITED STATES OF AMERICA,

By _____

Secretary of the Interior.

INTERNAL IRRIGATION DISTRICT,

By _____

President.

Attest:

Secretary.

20-139



NEWS RELEASE

A Century of
Water for the West
1902-2002

Mid-Pacific Region
Sacramento, California

MP-03-014
Jeffrey S. McCracken
916-978-5100

FOR IMMEDIATE RELEASE April 23, 2003

RECLAMATION INCREASES CVP APRIL 2003 WATER SUPPLY ALLOCATIONS

Reclamation today announced a 5 percent increase in water supply to South of the Delta Contractors from the Federal Central Valley Project (CVP). This increase is due to the above normal precipitation and the coordinated operations among CALFED agencies. Reclamation's official allocation uses the 90-percent exceedence forecast, which is based on a dry-year classification in the April 2003, water runoff information prepared by the California Department of Water Resources (DWR).

Reclamation has prepared two operations forecasts based on April 1, 2003, hydrologic conditions: one for dry-year conditions at a 90-percent probability of exceedence and one for below-normal conditions at a 50-percent probability of exceedence. Reclamation's forecasts indicate the same increase in water supply would be available under both hydrologies. The April 18 update of the water supply conditions, prepared by DWR, shows a significant increase in runoff conditions since the beginning of the month.

Mid-Pacific Region Water Year 2003 Supply Allocation April 23, 2003									
Probability of Exceedence Forecasts	Percent of Historical Average Sacramento Valley Index & Year Type	North of Delta Allocation				South of Delta Allocation			
		Ag	M &I	R	WR	Ag	M &I	R	W R
90%	76% Dry	100	100	100	100	65	90*	100	100
50%	81% Below Normal	100	100	100	100	65	90*	100	100
Recent Historic Average (5-Year Average Allocation)		92	96	100	100	71	91	100	100

**Municipal and Industrial supply is based on historical deliveries.*

At this time, the CVP Cross Valley Canal Contractors will receive an in-delta water supply of 65 percent. This water supply is dependent upon adequate capacity being available at the State Water Project Banks Pumping Plant to convey the water.

-more-

In both the 90-percent and 50-percent exceedence forecasts, there is no water supply allocation for the CVP East Side Division contractors (Stanislaus River).

In cooperation with CALFED agencies, Reclamation has developed and implemented an operations plan for 2003, which supports water supply reliability and fishery protections and restoration needs. The current plan employs water augmentation tools reflected in the forecast including use of the Environmental Water Account (EWA) assets to satisfy potential late spring export curtailments at the CVP Tracy Pumping Plant and efficient utilization of San Luis Reservoir storage. The supply to CVP contractors south of the Sacramento-San Joaquin River Delta was augmented recently when Reclamation filled the CVP share of San Luis Reservoir near Los Banos and used available capacity at Tracy Pumping Plant for about a week to export supplemental water.

The Friant Division deliveries for Water Year 2003 are projected to be 800,000 acre-feet or 53 percent of the historic water supply of 1.5 million acre-feet. The allocation for Friant Division contractors will be 100 percent of Class 1 water and 0 (zero) percent of Class 2 water. However, Reclamation will make available for class 2 contractors between 50,000 to 150,000 acre-feet of class 2 water during the uncontrolled season beginning on April 22, 2003 for a minimum of 5 days.

Reclamation will continue to monitor Millerton Lake and on a daily basis determine whether to extend or terminate the uncontrolled season. As part of this analysis, Reclamation will include a rolling 5-day forecast as to the likelihood of uncontrolled deliveries for each of the next 5 days. The projected Friant Division delivery of 800,000 acre-feet is based on DWR's 90-percent exceedence forecast. The 2003 precipitation season is about 90 percent complete. Through April 21, 2003, precipitation in the San Joaquin River watershed was 35.03 inches compared to 34.9 inches at this time last year.

Throughout the precipitation season, updated information will be provided as conditions warrant. For additional information on the Water Year 2003 Allocation press release, contact the Public Affairs Office at 916-978-5100, TDD 916-978-5608. In the coming months, additional information will continue to be posted on the Mid-Pacific Region's website at www.mp.usbr.gov.

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Reclamation is the largest wholesale water supplier and the second largest producer of hydroelectric power in the United States, with operations and facilities in the 17 Western States. Its facilities also provide substantial flood control, recreation, and fish and wildlife benefits.

20-140

**PALO VERDE IRRIGATION DISTRICT**

180 WEST 14TH AVENUE - BLYTHE, CALIFORNIA 92225

TELEPHONE (760) 922-3144 - FAX (760) 922-8294

Fax Transmittal SheetDate: 12/31/02To: Tina A. ShieldsCompany: Imperial Irrigation DistrictFAX #: 760-339-9009Office phone #: 760-339-9038From: Rogan@PVID phone #: 760-922-3144 officeYou should receive 5 page(s) including this cover sheet.Comments: As per your request, is letter.Unmeasured return estimated by USBR at 5.6% of diversion.Our letter does not show unmeasured return so 57064 acftwas submitted to get USBR approved #.



United States Department of the Interior

OFFICE OF THE SECRETARY

Washington, D.C. 20240

DEC 27 2002

Mr. Ed Smith, Manager
Palo Verde Irrigation District
180 West 14th Avenue
Blythe, California 92225-2889

Dear Mr. Smith:

By letter dated December 19, 2002, and pursuant to Part 417 of Title 43, Code of Federal Regulations (C.F.R.), the Palo Verde Irrigation District (PVID) requested diversions of 1.019 million acre feet (maf) at Palo Verde Diversion Dam, which results in an estimated consumptive use of 502,900 acre-feet (including unmeasured return flows).

Acting on behalf of the Secretary of the Interior (Secretary) and pursuant to a specific Delegation of Authority from the Secretary, this is the final 43 C.F.R. Part 417 determination of an approved Colorado River water order for PVID for CY 2003.

The availability of Colorado River water supplies is determined each year in the Annual Operating Plan (AOP). The Secretary adopted the 2003 AOP on December 16, 2002. The 2003 AOP provides that in the event the Quantification Settlement Agreement is not executed by December 31, 2002, there will be no surplus water available to the State of California and, in accordance with the Decree, the State will be limited to 4.4 maf of consumptive use of Colorado River water. Thus, based on water orders received by Reclamation for 2003, demand in California will exceed supply and the availability of water to junior users will depend on the quantity approved for senior right holders.

Reclamation has reviewed the District's 2003 water order in light of the Decree in Arizona v. California, and has determined the District's request to be appropriate under a water duty calculated from the 1979 Supplemental Decree. Based upon Reclamation's consultation with you on November 24, 2002 and the estimates of consumptive use required by the District, a consumptive use of 502,900 acre-feet is approved. We understand that the related diversion schedule and total diversions required will be about 1,019,000 acre-feet for calendar year 2003. This diversion includes 16,800 acre-feet of priority three water for the Mesa lands.¹

¹ A number of circumstances that may occur during CY 2003 could require further modifications to this approved water order. Such circumstances include, but are not limited to modification of the 2003 AOP, repayment for overuse pursuant to the 2002 AOP Supplement, and changes in the beneficial use requirements of water users in the Lower Basin States of Arizona, California and Nevada.

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12/27/2002 07:02 FAX 202 208 3324

PVID
A/S WATER & SCIENCE DOI

PAGE 03
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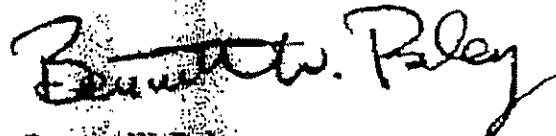
Mr. Ed Smith

2

Lastly, I note that in the Supplement to the 2002 AOP the Secretary established the requirement of a repayment for overruns in 2002, with the repayment to be calculated from the final decree accounting for 2002. At such time as the final accounting is available, Reclamation will determine the extent of any such overruns and notify PVID as to its repayment requirements, if any, which may result in a reduction in this approved water order for 2003.

Reclamation will be monitoring and projecting consumptive use of Colorado River water during calendar year 2003 to ensure that the annual entitlement of each water service contractor is not exceeded. These projections will be made available to PVID on a monthly basis. It is expected that PVID will use this information to adjust diversions to remain within approved annual quantities.

Sincerely,



Bennett W. Riley
Assistant Secretary
for Water and Science

cc: Commissioner, Bureau of Reclamation

Regional Director, Lower Colorado Region
Bureau of Reclamation

Mr. Gerald Zimmerman
Executive Director
Colorado River Board of
California
770 Fairmont Avenue, Suite 100
Glendale, California 91203-1035

Mr. Joseph C. Smith
Director
Arizona Department of Water Resources
500 North Third Street
Phoenix, Arizona 85004-3903

Mr. James H. Davenport
Chief, Water Division
Colorado River Commission of
Nevada
555 E. Washington Ave., Suite 3100
Las Vegas, Nevada 89101

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RESOURCES PLN & MGMT

PAGE 05

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PVID
A/S WATER & SCIENCE DOT

PAGE 04
0004/004

Mr. Ed Smith

3

bc: Secretary's Surname
Secretary's Reading File (2)
AS/WS (3)
ES
W-1125, W-1530
Area Manager, Yuma, Arizona
Attention: YAO-6200
Area Manager, Boulder City, Nevada
Attention: BCOO-1000
BCOO-4200

Daily Chrono-4200 WBR: SJones:pk:12/26/02:702-293-3186
T:\LTR\4200\4230\FY2003\Monthly Diversions\CA 03 PVID div approval.wpd

approved 502,900 acft by USBR 12/30/02
article in Comp. Valley Press,



PALO VERDE IRRIGATION DISTRICT

180 WEST 14TH AVENUE - BLYTHE, CALIFORNIA 92225

TELEPHONE (760) 922-3144 - FAX (760) 922-8294

December 19, 2002

Ruth M. Thayer - Group Manager
BUREAU OF RECLAMATION
Boulder Canyon Operations Office
P.O. Box 61470
Boulder City, NV 89006-1470

Attention: BCOO-4230 RES-3.10
RE: Revised Palo Verde Irrigation District 2003 Year Projected Water Use Request.

Dear Ms. Ruth Thayer

As per the Group Manager's request of July 10, 2002, I am furnishing this District's estimates of monthly diversions from, and surface returns to the Colorado River for calendar year 2003.

The point of diversion is the Palo Verde Diversion Dam and the surface return estimates have been segregated into two portions: that returning to the river above Taylor's Ferry, and that returning to the river below Taylor's Ferry. As you know, the major portion of our return flow enters the river through the Outfall Drain and the old river channel west of the Cambla cut.

Month	AC/FT Diversion	Return* Above T. Ferry	Return* Below T. Ferry	Total Return	Priority #1 Use	Priority #3 Use	Total Use
Jan	44,000	2,000	30,000	32,000	15,400	600	12,000
Feb	60,000	2,800	30,000	32,800	26,600	600	27,200
Mar	78,000	3,000	34,000	37,000	29,900	1,100	41,000
Apr	101,000	3,500	34,000	37,500	30,900	1,600	63,500
May	114,000	3,500	38,000	41,500	32,800	1,700	72,500
Jun	118,000	3,000	35,000	38,000	32,300	1,700	80,000
Jul	123,000	3,000	38,000	41,000	32,900	2,100	82,000
Aug	118,000	3,000	38,000	41,000	34,800	2,200	77,000
Sep	89,000	3,000	37,000	40,000	32,200	1,800	49,000
Oct	72,000	3,200	38,000	41,200	29,300	1,500	30,800
Nov	52,000	2,900	36,000	38,900	15,800	1,300	13,100
Dec	50,000	3,100	35,000	38,100	10,300	600	11,900
YTD	1,019,000	36,000	423,000	459,000	503,200	16,800	560,000
A/E							57,934

* Includes operational canal spill and drainage water.

502,900 approved 12/27

Very truly yours,

Hal H. Reynolds
Hal H. Reynolds
Water Master

Mr. Jim Cherry, Area Manager
United States Department of the Interior
Yuma Area Office
1401 Calle Agua Salada
Yuma, AZ 85364

Colorado River Board of California
Gerald R. Zimmerman, Executive Director
770 Fairmont Avenue, Suite 100
Glendale CA 91203-1035

Mr. Joseph C. Smith, Director
Arizona Dept. of Water Resources
500 North Third Street
Phoenix AZ 85004-3903

Mr. George M. Caan, Director
Colorado River Commission of Nevada
555 East Washington Ave, Suite 3100
Las Vegas NV 89101

120,500 ACRES LOCATED ALONG THE COLORADO RIVER

20-141

Secretary's Remarks to
Colorado River Water Users Association
Las Vegas, December 17, 1998

Today marks the fourth year that I have joined you at this annual meeting to review our progress on managing the Colorado River. As in past years, I am pleased to report considerable progress toward our common goal of more efficient use of our shared water resource. Indeed it has been a remarkable year, perhaps the most significant on the River in many decades, for we are now on the threshold of resolving some of the most intractable and elusive issues that bring us to these meetings.

Each year I have stressed two overarching themes that should always inform our efforts: 1) The desirability of resolving water controversies through stakeholder consensus; and 2) the importance of conservation and consensual water transfers and similar transactions. And we have made progress in these areas as well.

Last year, I discussed steps necessary to bring California into line with its entitlement under the Colorado River compact. At the same time, California issued its draft "4.4 Plan", which set the stage for a series of developments designed to implement that plan. And in the last year California has made impressive progress toward the 4.4 goal, which I would now like to review in some detail.

In April of this year, the San Diego County Water Authority and the Imperial Irrigation District executed a water conservation and transfer agreement that provides the means for an ag-to-urban transfer of increasing amounts of water, rising to potentially as much as 300,000 acre-feet per annum. While that arrangement is subject to a variety of state and federal requirements, the essential transaction between San Diego and the IID is one important building-block of the 4.4 Plan. This is in addition to the 1988 MWD/IID agreement, under which the Met is entitled to up to 106,000 acre-feet per year of conserved ag water pursuant to a contract whose conservation measures I understand to have been fully implemented within the last year.

A second important element of the Plan was advanced when San Diego and the Metropolitan Water District reached an agreement that will permit the transferred water to be delivered to San Diego via an exchange agreement.

The 4.4 Plan took yet another step forward when the State of California appropriated \$235 million to underwrite the lining of the All-American and Coachella Canals, and to implement groundwater conjunctive use programs, which will provide close to 100,000 acre-feet per year of conserved water, out of which both the San Luis Rey settlement can be implemented, and additional water will be provided to the Met. Met has opened discussions with the San Luis Rey

entitlement to exceed its 3.85 maf limit, IID and Coachella will absorb the shortage on a 90/10 basis.

- IID's entitlement will be capped at 3.1 maf, and will include water to be transferred to Met, Coachella and San Diego, ultimately leaving a net diversion entitlement to the IID of approximately 2.7 maf.
- Coachella's entitlement will be capped at 468,000 acre-feet, composed of its historical use of 330,000 acre-feet plus water to be transferred and conserved under the plan.
- Other elements of the negotiation are a "peace" agreement between the two agencies not to challenge each other's water practices, and an expectation that the Met will build a conjunctive use facility in the Coachella Valley.
- The districts will also agree to support the implementation of surplus guidelines designed to provide reasonable assurance that Met's aqueduct is kept full through 2015.

I am very impressed that Imperial and Coachella have at last discovered their fraternal bonds and negotiated such an impressive quantification approach. I personally want to extend my thanks to the negotiating teams for the two Districts and to the heads of the respective District boards who have participated in all the intensive discussions that led up to the MOU-Tellis Codekas of Coachella and Lloyd Allen of Imperial. These folks have stepped up to the plate and delivered, and I commend them for their accomplishment and the onset of a new era of goodwill and mutual cooperation.

A next important step involves the Met, holder of the next California priority under the 7-Party Agreement. Before signing on, Met is waiting for the final piece of the California Plan puzzle to fall into place. Its concerns about river operations are entirely appropriate and timely. And that brings me to the matter of surplus guidelines. The draft California 4.4 Plan anticipated a first phase, under which California's need for Colorado River water would be reduced to 4.8 maf by 2015. During that time period, California has anticipated that the State would continue to be reliant on some available surplus in order to keep its aqueduct full. It is now time to move forward with this concept. I am prepared, as these other elements of the California Plan proceed toward finalization and implementation, to put into effect surplus guidelines that address Met's need to maintain a full aqueduct during this period, subject to the following provision: as a condition for continued implementation of the surplus guidelines, California must meet a series of benchmarks we will identify, to be monitored by the Bureau of Reclamation, designed to prevent backsliding and assure that Phase 1 is being regularly implemented on a schedule that will step-by-step reduce California's call on the Colorado River to 4.8 maf or less by 2015.

As to the substance of the surplus guidelines, I am aware of the proposal prepared by six of the seven basin states dated December 4th. On this issue, as on others, I reiterate my preference that all the basin states search for a recommendation on which they can agree. In light of California's

conservation, account for transfers of water out of the Salton Sea Basin, and are based on a maximum likely reduction in inflows into the Salton Sea Basin which could be 800,000 acre-feet per year.”

As I have emphasized today, we are working closely with California entities on many fronts to make ag-to-urban transfers a reality. But I will simply point out the obvious – that identifying a workable, realistic and affordable way to manage the Salton Sea will be a very complex task.

All in all, though we are not at the end of the road, we have come a long way, and we have done so on the basis of negotiation designed to achieve consensus. I continue to be committed to the idea that consensus is the best way to administer this river. But to find common ground requires a willingness to accommodate. I believe we can find such ground on each of the remaining issues that I have discussed, so that every state and every entitlement holder can win, but with no winner-take-all. I prefer to be the facilitator of success and not the river-master issuing dictates from afar. I hope that, in the remaining time on my watch, we can continue and accelerate our work in the spirit of friendship and cooperation that has already produced so much progress.

20-142



Bureau of Reclamation

Managing Water in the American West

[More Speeches](#)

COLORADO RIVER WATER USERS ASSOCIATION

1997 Annual Conference

Caesars Palace

Las Vegas, Nevada

Address

by

Bruce Babbitt

Secretary of the Interior

December 18, 1997

During each of the past two years I have come before you at your annual conference to review the status of water administration in the Lower Basin and to identify some of the steps that I believe are necessary to achieve sound long-term management of the Colorado River. On each occasion I have emphasized the desirability of consensus among the basin states, and initiatives within the states--and particularly within California--to develop a realistic strategy to assure that the needs of each state can be met without jeopardizing the entitlement of others. I have, in each instance, pledged my cooperation and assistance in these efforts, while stating my readiness to act as necessary to fulfill my responsibilities pursuant to the Law of the River.

I am pleased to be able to report positive action on several fronts. We have taken a major step toward bringing to fruition the interstate transfer by state-authorized entities pursuant to off-stream banking programs in the Lower Basin, as I shall describe in a moment. California has been moving forward in its effort to produce a workable plan that will permit it to live within its Colorado River apportionment. Though much remains to be done, there is measurable progress. The time is now ripe for me to take some initiatives designed to help move the California process along the path on which it has embarked. I shall describe those initiatives shortly, but first I would like to report on some other important Colorado River developments.

It is paradoxical that our current efforts to come to terms with the challenges of scarcity on the River occur during one of the wettest periods in recent history. The 1997 water runoff was 144% of normal, and this autumn has been unusually wet. The flows into Lake Powell during the past few months have run nearly two times normal, and the Colorado River reservoir system is at its highest level since 1986. As a result releases from Flaming Gorge, Aspinall and Glen Canyon reservoirs have been much above normal this fall, and flood control releases at non-damaging levels from Hoover Dam are projected early in 1998.

El Nino is very much on everyone's mind, and we are engaged in detailed and ongoing efforts to assure that we schedule releases effectively in order to reach proper Reservoir elevations. In that way we can better prepare for the possibility of increased runoff from a heavy late Spring rain or snow. Channel work is nearing completion in the Yuma area and in Mexico to prepare for higher than normal flows, and emergency action plans and table-top exercises have been completed for Hoover, Davis and

Parker Dams. We are working diligently to handle anticipated high flows of water safely and effectively.

In light of the high level of system storage, I signed the 1998 Annual Operating Plan for the Colorado River Reservoirs, declaring a surplus which allows Colorado River water in excess of 7.5 million acre-feet to be used in the Lower Basin. A surplus for Mexico has also been determined and the International Boundary and Water Commission has informed Mexico that they may schedule an additional 200,000 acre-feet of use, pursuant to our Treaty. Depletions in the Lower Basin are expected to be about 8.2 million acre-feet in 1998, which presents no problem during a year like this one, but underlines why we are concerned that preparations be made for less abundant periods that are unavoidably before us.

Last year I noted that I had initiated an adaptive management process for future operation of Glen Canyon Dam to enable us to operate the dam so as to balance a variety of interests. We were able to show the benefits of that process recently when heavy rains in the Paria River basin deposited large quantities of sediment in the main channel of the Colorado River. A decision was made to run a test flow at full powerplant capacity to redeposit the sediment, and we did so successfully in early November. These are precisely the sort of innovative steps that adaptive management permits and encourages.

We are working together with the States, Tribes, environmental organizations and other interested stakeholders on the Lower Colorado River Multi-Species Conservation Program. The program plan is to provide protection for both currently listed threatened and endangered species and potentially listed species, along the Lower Colorado River. The plan is designed to address both the needs of the States for water and power production, and the consultation needs of the Bureau of Reclamation for River operations and maintenance.

This proposed program underscores our commitment to the restoration of threatened and endangered species, while addressing the water and power needs of the basin states. It is a cooperative endeavor that holds significant promise, and I applaud the Basin States for their commitment to work with us. It is also noteworthy as another demonstration of the workability of the basic requirements of the existing Endangered Species Act, when administered with sensitivity and imagination.

We are also turning our attention to the environmental challenges faced by the Salton Sea. I will be visiting the Salton Sea later this afternoon and tomorrow, and I am hopeful that we will soon be addressing its problems in cooperation with other interested parties.

I am pleased to be able to report positive developments in each of these areas. We are also progressing on that most stubbornly recalcitrant set of issues, water supply management in the Lower Basin. I would now like to turn to that subject.

OFFSTREAM STORAGE REGULATION

In my address last December, I said "I am instructing the Bureau of Reclamation to initiate a rulemaking process to develop water management regulations for the Lower Basin." I am pleased to announce that this process is now well underway. By the end of this month, the Bureau of Reclamation will publish in the Federal Register a proposed rule titled "Offstream Storage of Colorado River Water and Interstate Redemption or Transfer of Storage Credits in the Lower Division States". The proposed rule permits the States of Arizona, Nevada, and California to store Colorado River

Water offstream for interstate use within the Lower Division States. It creates a procedural framework through which state authorized entities within the Lower Division can develop storage credits associated with Colorado River water that is stored offstream, and then use or transfer these credits within the Lower Division. The preamble to this Rule will note the importance of providing an opportunity for Indian tribes to participate in such storage and transfer activities. We will be receiving comments on the proposed rule during the 60 days following its publication.

While the opportunities created by this rule will be available to each of the Lower Division states, the rule should be of particular assistance to Arizona, which has enacted an offstream banking program, and should prove especially helpful to Nevada as it prepares to meet its needs during the early years of the next century.

When this rule becomes final, we will have in place one significant element of the program that is needed to facilitate water transfers in the Lower Basin. It is, however, only one piece of the puzzle, and much remains to be done, particularly to meet California's long term requirement to bring its demand in line with available supply.

BENEFICIAL USE AND TRANSFERS IN CALIFORNIA

As I have emphasized on several occasions, market based transfers within California must be founded on a baseline quantum of beneficially-used water from which savings can be made. Thus far, efforts among the California agricultural agencies to achieve an agreed-upon quantification of entitlements from the Colorado River, and to settle long-standing differences about beneficial use, particularly within the Imperial Irrigation District, have been unsuccessful.

I want to reiterate the concern I expressed last year about California uses in excess of 4.4 million-acre feet. There is increased use in both the Palo Verde and Imperial Irrigation Districts. Though the agricultural entitlement under the first three priorities is only 3.85 million acre-feet per year, the agricultural districts have been using about 4 million acre-feet during each of the past several years. Indeed, except for the unusual years of 1992 and 1993, Imperial's diversions of Colorado River water have been steadily increasing over the past ten years. IID's diversions during the past two years have exceeded its long term average use by about 200,000 acre-feet per year, and that is in addition to some 106,000 acre-feet it is obliged to conserve under a transfer agreement with the Met.

This is a disturbing trend, and it is in tension with California's need to bring its use within its entitlement. I am aware of no convincing reason why the agricultural districts should be exceeding their 3.85 million acre-foot allotment. This year, for the first time, the Bureau of Reclamation declined to approve the initial IID diversion requested. In light of these developments, I am instructing the Bureau of Reclamation to scrutinize very carefully requests for deliveries in excess of long term averages by districts that are likely to result in total deliveries to the holders of the first three priorities that exceeds the 3.85 million acre-foot entitlement, and to report to me the implications of such requests for compliance with the statutory beneficial use limitation.

As steps are taken looking to ag-to-urban transfers of Colorado River water pursuant to the emerging California Plan, it becomes increasingly important that both beneficial use and quantification issues within the agricultural sector be resolved. So long as districts do not have fixed rights within the priorities of the seven party agreement, it becomes difficult if not impossible to ensure that water transfers do not end up increasing demand on the Colorado River. Moreover, if the only water transferred is water that otherwise would be wasted or not beneficially used, no net benefit to the

River would result. For these reasons, transfers must be founded on a baseline quantum of beneficially-used water from which savings can be made.

I have repeatedly encouraged efforts by the agricultural districts to achieve a negotiated quantification, and I want emphatically to reiterate that message today. Alternatively, should a negotiated settlement not be achieved prior to the time that a district seeks required Secretarial approval for a transfer, I shall determine, as a precondition to approval, the maximum quantum of water out of which a transfer can be made.

I am aware that a draft agreement for transfer of conserved water between the Imperial Irrigation District and the San Diego County Water Authority was made public last week. Such agreements are a positive and important step in moving the emerging California Plan toward implementation. Of course we have not yet studied the draft and I cannot comment on any of its specific provisions. I do want to emphasize, however, that the policy on transfer approvals that I have just described will be applied to agreements such as that proposed between IID and the San Diego County Water Authority.

SURPLUS CRITERIA

I said last year that I would direct the Bureau of Reclamation to continue to operate under current guidelines for annual decisions regarding surplus determinations in order to give California an opportunity to put in place a realistic strategy to assure that it will be able to reduce its use when necessary. We are not there yet. The draft California "4.4 Plan" that was issued in October of this year is, however, a necessary and desirable step. The Plan properly recognizes the need for programs that will allow California to meet its Colorado River water needs from within its annual apportionment of Colorado River water of 4.4 million acre-feet when neither surplus water nor apportioned but unused water is available.

While the Plan is literally a blank in some crucial specifics--it neither specifies a date by which California's uses of Colorado River water will be reduced, nor does it state the amount of reduction to be achieved by that unspecified date--it does identify the internal sources from which about one-half of the present excess demand is expected to be met: 106,000 acre-feet/year from the existing IID/MWD conservation agreement; 200,000 acre-feet/year from a proposed IID/San Diego (SDCWA) transfer; and some 93,000 acre-feet/year through seepage recovery from the All-American and Coachella Canals. These are promising sources (though they present some as-yet unanswered questions), and they appear to provide the base for a realistic, and implementable, California Plan. I was also particularly pleased to see a provision for resolution of the San Luis Rey Indian Water Rights Settlement, which I consider an essential element of any strategy, as a component of the Plan.

However, a number of very important problems remain to be resolved, not the least among them a resolution of beneficial use and quantification issues within the agricultural districts so that transfers can go forward, and arrangements for transportation of transferred water through the Met's and San Diego's aqueduct (wheeling).

As I understand it, this proposal to reduce demand by about 400,000 acre-feet/year comprises the first of two phases of the evolving California Plan. I noted last year that I would defer the development of guidelines implementing surplus criteria in order to give California an opportunity to put into place a realistic strategy for meeting its needs. Phase I of the draft California Plan outlines the elements of such a strategy. When further steps are taken so that firm commitments are in place for implementation of this phase of the Plan, including the execution of binding contracts, agreed-on

arrangements for transportation, and resolution of quantification and beneficial use issues, I will adopt surplus criteria that will permit California to continue to meet its beneficial use needs from the Colorado River. I anticipate that these criteria will be effective for a specified number of years, at which time they will expire of their own terms, and will be reviewed before they are renewed, in order to ensure that California continues to make reasonable forward progress in implementation of its strategic plan.

CONCLUSION

The rate of change in matters affecting the Colorado River can sometimes be frustratingly slow, but I believe important progress is being made. I acknowledge the efforts made by California to shape a strategy for living within its entitlement which is helping to set us in the right direction, and I appreciate the constructive engagement of the other Basin States in that effort. We are setting a precedent of fruitful federal-state cooperation on the Colorado River. As my comments today should make clear, I also believe the time has come for me as River Master to play a more active role.

Much remains to be done, and I know that it cannot all be done in the next year or two. There are additional opportunities for marketing across state lines, and unfinished business relating to Tribal water rights. I reiterate my commitment to working within the Law of the River, to an insistence on prudent, non-wasteful use, and on the benefits of imaginative uses of marketing to implement voluntary, willing-buyer, willing-seller transactions. If we keep at it, we will be able to assure that every need will be addressed and that no entitlement holder, or state, will be disadvantaged.

COLORADO RIVER WATER USERS ASSOCIATION

1997 Annual Conference
Caesars Palace
Las Vegas, Nevada

Address
by
Bruce Babbitt
Secretary of the Interior
9:30 a.m., December 18, 1997

During each of the past two years I have come before you at your annual conference to review the status of water administration in the Lower Basin and to identify some of the steps that I believe are necessary to achieve sound long-term management of the Colorado River. On each occasion I have emphasized the desirability of consensus among the basin states, and initiatives within the states--and particularly within California--to develop a realistic strategy to assure that the needs of each state can be met without jeopardizing the entitlement of others. I have, in each instance, pledged my cooperation and assistance in these efforts, while stating my readiness to act as necessary to fulfill my responsibilities pursuant to the Law of the River.

I am pleased to be able to report positive action on several fronts. We have taken a major step toward bringing to fruition the interstate transfer by state-authorized entities pursuant to off-stream banking programs in the Lower Basin, as I shall describe in a moment. California has been moving forward in its effort to produce a workable plan that will permit it to live within its Colorado River apportionment. Though much remains to be done, there is measurable progress. The time is now ripe for me to take some initiatives designed to help move the California process along the path on which it has embarked. I shall describe those initiatives shortly, but first I would like to report on some other important Colorado River developments.

It is paradoxical that our current efforts to come to terms with the challenges of scarcity on the River occur during one of the wettest periods in recent history. The 1997 water runoff was 144% of normal, and this autumn has been unusually wet. The flows into Lake Powell during the past few months have run nearly two times normal, and the Colorado River reservoir system is at its highest level since 1986. As a result releases from Flaming Gorge, Aspinall and Glen Canyon reservoirs have been much above normal this fall, and flood control releases at non-damaging levels from Hoover Dam are projected early in 1998.

El Niño is very much on everyone's mind, and we are engaged in detailed and ongoing efforts to assure that we schedule releases effectively in order to reach proper Reservoir elevations. In that way we can better prepare for the possibility of increased runoff from a heavy late Spring rain or snow. Channel work is nearing completion in the Yuma area and in Mexico to prepare for higher than normal flows, and emergency action plans and table-top exercises have been completed for Hoover, Davis and Parker Dams. We are working diligently to handle anticipated high flows of water safely and effectively.

In light of the high level of system storage, I signed the 1998 Annual Operating Plan for the Colorado River Reservoirs, declaring a surplus which allows Colorado River water in excess of 7.5 million acre-feet to be used in the Lower Basin. A surplus for Mexico has also been determined and the International Boundary and Water Commission has informed Mexico that they may schedule an additional 200,000 acre-feet of use, pursuant to our Treaty. Depletions in the Lower Basin are expected to be about 8.2 million acre-feet in 1998, which presents no problem during a year like this one, but underlines why we are concerned that preparations be made for less abundant periods that are unavoidably before us.

Last year I noted that I had initiated an adaptive management process for future operation of Glen Canyon Dam to enable us to operate the dam so as to balance a variety of interests. We were able to show the benefits of that process recently when heavy rains in the Paria River basin deposited large quantities of sediment in the main channel of the Colorado River. A decision was made to run a test flow at full powerplant capacity to redeposit the sediment, and we did so successfully in early November. These are precisely the sort of innovative steps that adaptive management permits and encourages.

We are working together with the States, Tribes, environmental organizations and other interested stakeholders on the Lower Colorado River Multi-Species Conservation Program. The program plan is to provide protection for both currently listed threatened and endangered species and potentially listed species, along the Lower Colorado River. The plan is designed to address both the needs of the States for water and power production, and the consultation needs of the Bureau of Reclamation for River operations and maintenance.

This proposed program underscores our commitment to the restoration of threatened and endangered species, while addressing the water and power needs of the basin states. It is a cooperative endeavor that holds significant promise, and I applaud the Basin States for their commitment to work with us. It is also noteworthy as another demonstration of the workability of the basic requirements of the existing Endangered Species Act, when administered with sensitivity and imagination.

We are also turning our attention to the environmental challenges faced by the Salton Sea. I will be visiting the Salton Sea later this afternoon and tomorrow, and I am hopeful that we will soon be addressing its problems in cooperation with other interested parties.

I am pleased to be able to report positive developments in each of these areas. We are also progressing on that most stubbornly recalcitrant set of issues, water supply management in the Lower Basin. I would now like to turn to that subject.

OFFSTREAM STORAGE REGULATION

In my address last December, I said "I am instructing the Bureau of Reclamation to initiate a rulemaking process to develop water management regulations for the Lower Basin. " I am pleased to announce that this process is now well underway. By the end of this month, the Bureau of Reclamation will publish in the Federal Register a proposed rule titled "Offstream Storage of Colorado River Water and Interstate Redemption or Transfer of Storage Credits in the Lower Division States". The proposed rule permits the States of Arizona, Nevada, and California to store Colorado River Water offstream for interstate use within the Lower Division States. It creates a procedural framework through which state authorized entities within the Lower Division can develop storage credits associated with Colorado River water that is stored offstream, and then use or transfer these credits within the Lower Division. The preamble to this Rule will note the importance of providing an opportunity for Indian tribes to participate in such storage and transfer activities. We will be receiving comments on the proposed rule during the 60 days following its publication.

While the opportunities created by this rule will be available to each of the Lower Division states, the rule should be of particular assistance to Arizona, which has enacted an offstream banking program, and should prove especially helpful to Nevada as it prepares to meet its needs during the early years of the next century.

When this rule becomes final, we will have in place one significant element of the program that is needed to facilitate water transfers in the Lower Basin. It is, however, only one piece of the puzzle, and much remains to be done, particularly to meet California's long term requirement to bring its demand in line with available supply.

BENEFICIAL USE AND TRANSFERS IN CALIFORNIA

As I have emphasized on several occasions, market based transfers within California must be founded on a baseline quantum of beneficially used water from which savings can be made. Thus far, efforts among the California agricultural agencies to achieve an agreed-upon quantification of entitlements from the Colorado River, and to settle long-standing differences about beneficial use, particularly within

the Imperial Irrigation District, have been unsuccessful.

I want to reiterate the concern I expressed last year about California uses in excess of 4.4 million-acre feet. There is increased use in both the Palo Verde and Imperial Irrigation Districts. Though the agricultural entitlement under the first three priorities is only 3.85 million acre-feet per year, the agricultural districts have been using about 4 million acre-feet during each of the past several years. Indeed, except for the unusual years of 1992 and 1993, Imperial's diversions of Colorado River water have been steadily increasing over the past ten years. IID's diversions during the past two years have exceeded its long term average use by about 200,000 acre-feet per year, and that is in addition to some 106,000 acre-feet it is obliged to conserve under a transfer agreement with the Met.

This is a disturbing trend, and it is in tension with California's need to bring its use within its entitlement. I am aware of no convincing reason why the agricultural districts should be exceeding their 3.85 million acre-foot allotment. This year, for the first time, the Bureau of Reclamation declined to approve the initial IID diversion requested. In light of these developments, I am instructing the Bureau of Reclamation to scrutinize very carefully requests for deliveries in excess of long term averages by districts that are likely to result in total deliveries to the holders of the first three priorities that exceeds the 3.85 million acre-foot entitlement, and to report to me the implications of such requests for compliance with the statutory beneficial use limitation.

As steps are taken looking to ag-to-urban transfers of Colorado River water pursuant to the emerging California Plan, it becomes increasingly important that both beneficial use and quantification issues within the agricultural sector be resolved. So long as districts do not have fixed rights within the priorities of the seven party agreement, it becomes difficult if not impossible to ensure that water transfers do not end up increasing demand on the Colorado River. Moreover, if the only water transferred is water that otherwise would be wasted or not beneficially used, no net benefit to the River would result. For these reasons, transfers must be founded on a baseline quantum of beneficially-used water from which savings can be made.

I have repeatedly encouraged efforts by the agricultural districts to achieve a negotiated quantification, and I want emphatically to reiterate that message today. Alternatively, should a negotiated settlement not be achieved prior to the time that a district seeks required Secretarial approval for a transfer, I shall determine, as a precondition to approval, the maximum quantum of water out of which a transfer can be made.

I am aware that a draft agreement for transfer of conserved water between the Imperial Irrigation District and the San Diego County Water Authority was made public last week. Such agreements are a positive and important step in moving the emerging

California Plan toward implementation. Of course we have not yet studied the draft and I cannot comment on any of its specific provisions. I do want to emphasize, however, that the policy on transfer approvals that I have just described will be applied to agreements such as that proposed between IID and the San Diego County Water Authority.

SURPLUS CRITERIA

I said last year that I would direct the Bureau of Reclamation to continue to operate under current guidelines for annual decisions regarding surplus determinations in order to give California an opportunity to put in place a realistic strategy to assure that it will be able to reduce its use when necessary. We are not there yet. The draft California "4.4 Plan" that was issued in October of this year is, however, a necessary and desirable step. The Plan properly recognizes the need for programs that will allow California to meet its Colorado River water needs from within its annual apportionment of Colorado River water of 4.4 million acre-feet when neither surplus water nor apportioned but unused water is available.

While the Plan is literally a blank in some crucial specifics--it neither specifies a date by which California's uses of Colorado River water will be reduced, nor does it state the amount of reduction to be achieved by that unspecified date--it does identify the internal sources from which about one-half of the present excess demand is expected to be met: 106,000 acre-feet/year from the existing IID/MWD conservation agreement; 200,000 acre-feet/year from a proposed IID/San Diego (SDCWA) transfer; and some 93,000 acre-feet/year through seepage recovery from the All-American and Coachella Canals. These are promising sources (though they present some as-yet unanswered questions), and they appear to provide the base for a realistic, and implementable, California Plan. I was also particularly pleased to see a provision for resolution of the San Luis Rey Indian Water Rights Settlement, which I consider an essential element of any strategy, as a component of the Plan.

However, a number of very important problems remain to be resolved, not the least among them a resolution of beneficial use and quantification issues within the agricultural districts so that transfers can go forward, and arrangements for transportation of transferred water through the Met's and San Diego's aqueduct (wheeling).

As I understand it, this proposal to reduce demand by about 400,000 acre-feet/year comprises the first of two phases of the evolving California Plan. I noted last year that I would defer the development of guidelines implementing surplus criteria in order to give California an opportunity to put into place a realistic strategy for meeting its needs. Phase I of the draft California Plan outlines the elements of such a strategy. When further steps are taken so that firm commitments are in place for implementation of this phase of the Plan, including the execution of binding contracts,

agreed-on arrangements for transportation, and resolution of quantification and beneficial use issues, I will adopt surplus criteria that will permit California to continue to meet its beneficial use needs from the Colorado River. I anticipate that these criteria will be effective for a specified number of years, at which time they will expire of their own terms, and will be reviewed before they are renewed, in order to ensure that California continues to make reasonable forward progress in implementation of its strategic plan.

CONCLUSION

The rate of change in matters affecting the Colorado River can sometimes be frustratingly slow, but I believe important progress is being made. I acknowledge the efforts made by California to shape a strategy for living within its entitlement which is helping to set us in the right direction, and I appreciate the constructive engagement of the other Basin States in that effort. We are setting a precedent of fruitful federal-state cooperation on the Colorado River. As my comments today should make clear, I also believe the time has come for me as River Master to play a more active role.

Much remains to be done, and I know that it cannot all be done in the next year or two. There are additional opportunities for marketing across state lines, and unfinished business relating to Tribal water rights. I reiterate my commitment to working within the Law of the River, to an insistence on prudent, non-wasteful use, and on the benefits of imaginative uses of marketing to implement voluntary, willing-buyer, willing-seller transactions. If we keep at it, we will be able to assure that every need will be addressed and that no entitlement holder, or state, will be disadvantaged.

-end-

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W. Fanning
Bureau

COLORADO RIVER WATER USERS ASSOCIATION

1996 Annual Conference
Colorado River - Gateway To the 21st Century
CAESARS PALACE
LAS VEGAS

Address
by
Bruce Babbitt
Secretary of the Interior
10:00 a.m., December 19, 1996

Almost exactly one year ago, on the occasion of your 50th annual convention, I came before you here in Las Vegas to review the status of water administration in the Lower Basin and to make some observations about future directions. I then expressed the hope that a consensus on water management could be forged among the basin states, and that a mediation process then in place could help to move contending interests closer to a resolution of their differences, as steps toward sound long-term management in the Lower Colorado River.

At that time I described in some detail the contentious history of the River, a story that is guaranteed to temper the optimism of even the most hopeful souls. Today I have to report that while I am disappointed that more progress has not been made, I cannot say I am astonished. The Colorado River continues to test the commitment and the endurance of everyone who has been participating in the efforts of the last twelve months. It also has a nearly limitless capacity to generate new controversy. Before turning to the contentious matters that face us, however, I want to emphasize some good Colorado River news of 1996.

In April we completed our first spike flow release from Glen Canyon Dam, creating an artificial flood in the Grand Canyon to reestablish beaches and improve the natural habitat in the floor of the Canyon. The release has helped us to manage and improve the ecosystem of the Canyon in ways that exceeded our expectations. We appreciate the cooperation we have received

from the Basin States, the Tribes, and power users in implementing this unique water management program.

On October 9th of this year, I signed the record of decision completing the Glen Canyon Dam EIS that was begun in 1989. That decision initiated the adaptive management process for future operation of Glen Canyon Dam. This process enables us to operate the dam so as to balance the needs of recreation, the environment, cultural resources, water delivery, and hydropower generation.

We have entered into a partnership and funding agreement with the Lower Basin States and other interested parties to develop a multi-species management plan for the Lower Basin. Formal interim § 7 consultation between the Bureau of Reclamation and the Fish and Wildlife Service on river operations is ongoing and should be concluded in the Spring of 1997. Our plan is that a long term multi-species management plan will supersede the interim consultation, and will simultaneously provide both for protection of threatened and endangered species in the Lower Basin and for continued delivery of water and power benefits from the river.

I also want to commend the efforts of Governor Romer and Lt. Governor Shoettler of Colorado, who have convened a process for the purpose of seeking a resolution of the protracted controversy over the Animas-La Plata project. They have done so at considerable political risk, and the issues are divisive and emotional. I have given the process my full support. It is moving along satisfactorily so far, and it may provide a helpful model for negotiated settlement of knotty problems within the Colorado River Basin.

On the other side of the ledger, in California serious unresolved controversies remain both between agricultural agencies, and among the urban water suppliers. No progress is being made toward a settlement of the San Luis Rey water claims as directed by Congress. The mediation process that was taking place has ground to a halt.

It is a matter of special sensitivity that the concerns of other Basin states with the long term future of California's demands on the Colorado River have not been addressed. To be sure, this is only the most recent version of an issue that has been

central to Colorado River controversy for seven decades. When California was pressing for the construction of Boulder Dam in the 1920's, other Basin states were concerned that its rapid development would gain it the lion's share of the river under prior appropriation principles, to their disadvantage. This fear prompted the development of the Colorado River Compact in 1922, and the provision in the 1928 Boulder Canyon Project Act requiring California to enact a law limiting its Colorado River contractors to normal year use of 4.4 million acre-feet (maf).

California's uses are expected to go above 5.2 maf this year, exceeding by some 800,000 acre-feet its basic entitlement of 4.4 maf. In contrast to the past, however, the unused Lower Basin apportionment upon which California has relied is shrinking. For the first time ever, this year, demand for water in the Lower Basin exceeded the Basin's basic apportionment of 7.5 maf. Demand is expected to exceed 8 million acre-feet this coming year. Consumption in each of the three lower division states has been growing, and we can anticipate that with present patterns of use, demand will continue regularly to exceed 7.5 maf.

Fortunately, in the last few years water has been abundant. We have approximately 50 maf in storage on the Colorado River system, some 83% of system capacity. Analysis shows a very low risk of future shortage. For these reasons, we declared a surplus condition that allowed all Lower Basin water demand to be met in calendar year 1996. We anticipate a similar decision for 1997. However, conditions of abundance will not always prevail, and users in the Lower Basin cannot depend on surpluses always being available.

The six Basin states other than California have proposed discussions to develop multiple year surplus and shortage criteria that will for an interim period meet at least part of the demand in the Lower Basin. This is a significant proposal, but it is based on California's ability to commit to an enforceable program to reduce its reliance on surplus water, without creating undue risk to other entitlement holders.

A crucial question is how California is preparing itself for times of greater stringency. Its uses in excess of 4.4 maf are occurring both in the agricultural and in the urban sectors. The agricultural agencies have an entitlement of 3.85 maf, but called for more than 4 maf this year. There is

increased use in both the Palo Verde and Imperial Irrigation Districts. The Metropolitan Water District has been using about 1.2 maf of Colorado River water.

Where is California going? Apparently, considerable reliance is being put on the prospect of intrastate water marketing, in particular on transfers of Colorado River water from agricultural to urban use. Presumably, much of that water would come from agricultural efficiency gains based on water saved through conservation technologies, funded by urban interests. That was the approach taken in a 1989 MWD/IID conservation plan designed to generate about 100,000 acre-feet per year. Other techniques that have been explored are dry-year options, a means for meeting short term deficits in supply through voluntary agreements by farmers to forego use of river water during periods of shortage; and land fallowing, a more controversial approach because of its potential impact on agricultural communities. During the last year, IID and San Diego initiated an ambitious effort aimed at transferring large quantities of water--several hundred thousand acre-feet per year--from the Imperial Valley to the city.

Water Transfers Through Marketing

As I emphasized last year, I believe that water marketing is an important tool that can help us to use the water in the Colorado River more effectively, and in particular that it can be important in meeting California's long term need to bring its demand in line with available supply. However, some serious obstacles stand in the way of implementing market-based transfers. I believe I can now usefully take several steps to help effectuate such transfers, consistent with the Law of the River and the fundamental precept that our goal is management of the River to make the most effective use of the limited resource we have. I am initiating the following actions regarding marketing:

1. First, transfers must be founded on a baseline quantum of beneficially-used water from which savings can be made. I know that some basin interests have expressed concern about increased water use by the Imperial Irrigation District attributable to various factors, including changing cropping patterns. We have some real concern about this as well. The Bureau of Reclamation has been working on a cooperative arrangement with the Imperial Irrigation District to determine the amount of water IID is beneficially using. This is a desirable step, and I have instructed the Bureau to seek to implement it as expeditiously as possible. Such

collaborative and cooperative efforts are preferable to the use of regulatory strictures, which is the alternative means of determining beneficial use, and which I, as well as the state, have authority to implement if necessary. Once such a baseline is determined, marketing opportunities will be one step closer to reality.

2. Second, I am instructing the Bureau of Reclamation to initiate a rulemaking process to develop water management regulations for the Lower Basin. As you know, the Bureau began such an effort several years ago, but deferred further work to allow a consensus to develop among the states on approaches to interstate marketing and banking. Those efforts were unsuccessful. This time, the regulations will focus on: intrastate marketing; and interstate marketing within the Lower Basin based on state-approved, willing buyer/willing seller transactions. The regulations may be expanded if the public scoping process identifies other water management activities that could be incorporated in them, without generating significant controversy or delay.

I want to take special note of an Arizona initiative. It has put in place a groundwater banking program that will enable it to store Colorado River water offstream for future use. This program, when operated in conjunction with the Arizona Groundwater Law that was enacted during my tenure as Governor, will help protect Arizona against possible Colorado River shortages it may have to bear. The Arizona program includes an interstate component which would permit Nevada and California to store Colorado River water to help meet future needs in those states. Nevada believes the Arizona plan offers real potential for it to meet its future water needs, at least for a considerable time. I view this as a positive approach and I propose to issue regulations that will authorize programs of this kind.

3. Another obstacle to marketing is the unclarity of the relative rights of various agricultural agencies in California under the Seven Party Agreement of August 18, 1931, and under a subsequent 1934 agreement between the Imperial Irrigation District and the Coachella Valley Water District. Clarification of agricultural rights subject to the Seven Party Agreement, and settlement of the long-festering dispute between Coachella and IID, are also likely to be crucial to effectuating transfers in California from agricultural to urban users. Such transfers would be a key component of the plan sought by the other six basin states, by which California can limit its Colorado River water use. Such a plan will need to include a clear and more definitive interpretation of water entitlements among the California

agricultural agencies. We stand ready to assist, and if necessary to assume leadership, in clarifying the relative rights of the parties, as a precondition to water marketing.

Each of the preceding matters is an initiative that I intend to get underway beginning in the next calendar year.

In reflecting on the controversy generated by the Seven Party Agreement, I have noted striking parallels in the circumstance of several of the entities who depend on the water of the Colorado River: a situation of uncertainty about ability to meet needs as a result of being in a subordinate, and potentially perilous, position. In a broad sense, Coachella's posture vis-à-vis IID is like San Diego's vis-à-vis other Met customers, like the Met as to the agricultural contractors, and like that of the Central Arizona Project in relation to the other Lower Basin states. Most of these matters will be taken up in the fullness of time. Each has its own history, and its own equities. Still, we need to keep in mind that in the long term the great issue on the River is providing confidence to every stakeholder that its reasonable needs can be met in good times and bad, without the risk of drastic measures.

There are several other issues that need attention on our shorter term agenda, and I now want to turn to them.

Surplus Criteria

The time is ripe for the formulation of criteria that will govern the declaration of surplus conditions. Surplus guidelines will provide a basis for Lower Basin water users to rely upon in assessing the future availability of Colorado River water and in making appropriate plans for meeting water needs. I shall direct the Bureau of Reclamation to initiate the development of guidelines for annual decisions regarding surplus determinations in operating the River.

It is clear that surplus water will not be available indefinitely to meet demands beyond the 4.4 million acre-foot entitlement of California. The prospect of long-term reliance on such water by users in California is a matter of great concern to other states in both basins. The effective implementation of surplus criteria depends on the presence of a well-conceived strategy within California designed to cope with its long term demands on the River. I shall therefore temporarily defer making any

such guidelines final in order to give California an opportunity to put in place a realistic strategy to assure that it will be able to reduce its use when necessary, or to meet its needs from sources that do not jeopardize the entitlement of others.

Banking

I continue to believe, as I observed last year, that some forms of banking, which may include top-water banking, are useful tools that can contribute to more effective management of the River, encouraging additional conservation. Since conservation incentives are one of the most important tools we have in encouraging efficient use of the limited resource we have, I believe banking should remain in our arsenal of techniques. However, considering the intense level of controversy top-water banking spawns, I believe formal regulatory consideration should be left to a later time. I shall, however, stand ready to entertain specific proposals for top-water banking that are put before me, on a case-by-case basis, particularly where there is a potential to demonstrate innovative conservation methods. Any such proposals will be subject to public review and input from interested parties.

The San Luis Rey Settlement

I am distressed that we have still not been able to effect a settlement of water rights claims with the five bands of Indians in San Diego County, and I intend to continue to search out means, with the cooperation and participation of California stakeholders in the Colorado River, to effectuate a settlement consistent with the law enacted by Congress in 1988. Securing such a settlement is in my view key to advancing Colorado River issues of interest to the State of California.

Conclusion

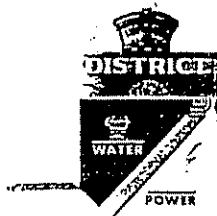
Before closing, I want to emphasize that I have been addressing only Lower Basin matters, and only water supply problems, not environmental issues, which are being addressed in separate forums. I also want to reiterate my commitment to working within the Law of the River, and to assuring that the entitlement of each contractor and of each Basin State is

unimpaired. Nor, despite the disappointments of the past year, is there any diminution in my desire to continue searching for consensus on River management issues.

I want to conclude by reiterating the essence of what I said last year. I believe that we have the management tools to make it possible to assure every Basin State that it will be able to meet the needs of all its citizens. But that can only be the case if we work together to put those tools to use. We must insist on prudent, non-wasteful use. We must be imaginative in utilizing marketing, and in encouraging voluntary, willing-buyer/willing-seller markets. We must be creative in seeking out mutually advantageous arrangements both within and among states. With those commitments, we can, step by step, provide assurance that every need will be addressed and that no entitlement holder, or state, will be disadvantaged.

-end-

20-144



IMPERIAL IRRIGATION DISTRICT

OPERATING HEADQUARTERS • P O BOX 937 • IMPERIAL CALIFORNIA 92251

WD-WR

January 22, 1992

Mr. Robert J. Towles
Regional Director
United States Bureau of Reclamation
Lower Colorado Regional Office
P.O. Box 61470
Boulder City, NV 89006-1470

Dear Mr. Towles:

In response to your letter dated December 9, 1991, Imperial Irrigation District (IID) is preparing a water conservation contingency plan for possible implementation in calendar year 1992. The IID's response to the United States Bureau of Reclamation (USBR) request is outlined in this letter which includes a general overview of the elements of the potential water conservation contingency plans.

As you are well aware, among the Colorado River Lower Basin water users, the agricultural agencies are entitled to 3.85 maf as a result of the 1931 California Seven Party Agreement. If any contingency measures were required for implementation, a determination of prioritization of water rights must be made as to which agency is required to cut back its water use and implement the water conservation measures first.

If the USBR requests that agricultural agencies reduce their diversions below 3.85 maf, IID would be willing to negotiate a contract with Metropolitan Water District of Southern California (MWD) to implement an "emergency conservation program" to provide additional water to MWD above its entitlement to allow MWD to divert at full capacity for all of calendar year 1992.

Two short-term irrigation water use reduction programs are being investigated by IID. Pilot studies have been conducted in IID to determine the possible water use reductions that can be achieved. The results of the pilot studies have not been finalized and the associated costs and the magnitudes of water use reduction by implementation of these programs have not yet been determined. The potential measures include the alfalfa water use reduction and the flooding/leaching water use reduction programs.

It is recognized that due to the deleterious effects to the soil and crop productivity that will result from the long-term implementation of these programs, they cannot be implemented every year. Therefore, the timing of arrangements of the programs is critical for maintaining adequate crop productivity in subsequent years.

The alfalfa water use reduction program could be implemented during the period in which the occurrence of highest irrigation water requirements and the lowest crop yields are coincidental. This period is known to occur approximately between the beginning of August and the middle of October and results in the lowest crop productivity to water use volume ratios. The flooding/leaching program could begin on May 1 and continue as needed by the required reductions in the annual water use.

Using IID's historical annual water diversions data, a frequency analysis of annual water demand will be performed several months ahead of time and will be updated for each month to determine the probability of exceeding the allowable water supplies for the remainder of the year. The probability of exceedences will form the basis for forecasting water demand for IID and will determine the need for the implementation of water conservation contingency plans.

Sincerely,

A handwritten signature in cursive script, reading "Charles L. Shreves".

CHARLES L. SHREVES
General Manager

AA

WC1(10)

20-145

**IMPERIAL IRRIGATION DISTRICT
WATER CONSERVATION CONTINGENCY PLAN**

Submitted to:

UNITED STATES BUREAU OF RECLAMATION

DRAFT
7/17/92

*not sure if
this was
ever finalized
or sent to USBR*

**IMPERIAL IRRIGATION DISTRICT
WATER RESOURCES UNIT
July 17, 1992**

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1.0 INTRODUCTION

In a letter from the United States Bureau of Reclamation (USBR), dated December 9, 1991, Imperial Irrigation District (IID) has been requested to provide a Water Conservation Contingency Plan. The Contingency Plan would be requested for implementation if the Colorado River Lower Basin water use is forecasted to exceed 7.5 million acre-feet by the end of each water year.

IID's response to USBR's request is presented in this report which includes descriptions of the emergency water conservation programs and the volume of water that could be conserved with each program. This IID Plan has been prepared to continue to emphasize the District philosophy of being cooperative whenever there are possible water shortages. However, we do not believe that the Bureau has the authority or regulations that would allow implementation, except as a voluntary action by the District.

Three short-term irrigation water use reduction programs have been investigated by IID and have been found feasible for possible implementation. These plans include the: 1) modified alfalfa irrigation, 2) flooding/leaching, and 3) land fallowing water use reduction programs.

The modified alfalfa irrigation and land fallowing programs will be implemented based on individual agreements between participating farmers and the IID. The programs will be advertised and the farmers will participate in the programs on a voluntary basis. However, if further emergency water conservation measures are requested, the flooding/leaching program can be implemented on a mandatory basis to reduce water use. IID and the participating farmers will need to be compensated for all costs incurred by implementation of the water conservation contingency programs if an agency other than IID is the program beneficiary. The number of years that these programs could be implemented is not known. There

are risks of long-term adverse effects to soil and crop productivity which would need to be recognized through appropriate compensation.

Currently IID is in the process of negotiating a Test Water Conservation Program agreement with Metropolitan Water District of Southern California (MWD) to reduce water use by 100,000 acre-feet annually for the next two years through the land fallowing and modified alfalfa irrigation programs. The costs associated with these programs have not yet been finalized and compensation terms are being negotiated. The programs have been advertised and farmers may participate in either or both of these programs on a voluntary basis. The plan calls for compensation by MWD to the participating farmers and the IID on a cost per acre-foot of water transferred basis.

2.0 WATER CONSERVATION CONTINGENCY PROGRAMS

2.1 Alfalfa water use reduction

The alfalfa water use reduction program shall eliminate the irrigation of alfalfa on a voluntary basis as an emergency drought response measure. The program could begin on or about August 1 and continue for a period of approximately 75 days, or as determined by the Water Conservation Advisory Board (WCAB) Special Committee. The program shall be administered by the IID Water Department.

Based on a pilot study conducted in 1991 for 75 consecutive days between August 1 and October 15, it was estimated that such a program can reduce water use by 1.36 acre-feet/acre each year. Yield records collected during the study indicate a production loss of 2.8 tons/acre. The costs associated with this program consist of grower and IID compensation costs.

2.2 Flooding/leaching water use reduction

The flooding/leaching water use reduction program is intended to limit water use on irrigated lands by imposing a limit on the time period water is applied to lands not under crop production. The program shall be conducted by the IID Water Department which will be responsible for carrying out the program guidelines. The program can begin on May 1 and will be in effect as determined by the WCAB Special Committee.

Specifically, the following rules will be applied in the administration of the program:

Rule #1

A time limit of 0.9 hour/acre rounded to the nearest 12-hour period shall be enforced on all non-crop irrigation water orders. The minimum allowable time period will be 48 hours. A penalty consisting of double the normal charge for all water delivered in excess of the allowable time limit shall be assessed. In situations where physical conditions do not allow water to be applied in large enough flow rates to meet guidelines, the water order may be reduced and an additional 24 hours of application time may be allowed. The tailwater assessment rule will also be applied which consists of a penalty of triple the normal charge in cases when there is any measurable waste water; except in the last day of irrigation if the tailwater runoff exceeds 5% of the water order.

Rule #2

Double flat flooding will not be allowed except in the case of extreme moisture depletion conditions from sandy soils prior to cropping. The same limitations and penalties shall be applied to the second flooding as in Rule #1.

According to a pilot study conducted in IID between May 22 and October 18, 1991, a water use reduction of 0.3 acre-feet/acre can be achieved by implementation of this program. It must be recognized that reduced flooding/leaching program may result in increased soil salinization and a decline in crop productivity. Therefore, particular attention will be given to the assessment of the optimal duration of the program to prevent soil salinity from rising above intolerable levels. The costs associated with the program consist of grower and IID compensation costs.

2.3 Land fallowing

The land fallowing program will allow farmers, on a voluntary basis, to take land out of agricultural production. Farmers will be requested to submit their total farmable acreage and specific gate location. From IID's records, indicating the water use history of the land, a water transfer allotment will be established. Based on the farmer's allotment and water use history, IID will determine the amount of acreage to be included in the program. The program will be in effect for one year or as determined by the WCAB Special Committee.

Once the fallowed acreage has been determined, the farmer will be responsible for ensuring that the water will not enter the field or portions of the field included in the program. IID will monitor the field to assure compliance with the program.

Estimates of water conservation associated with this program have not yet been developed. Based on the Test Water Conservation Program, which is currently under development, participating farmers and IID will be compensated for all costs on a per acre-foot of water transferred basis.

3.0 SUMMARY

The Plan presented in this report outlines the water conservation contingency programs and procedures for implementation of each program. These programs include the 1) modified alfalfa irrigation, 2) flooding/leaching, and 3) land fallowing water use reduction programs. The modified alfalfa irrigation and land fallowing programs can be implemented on a voluntary basis during years that the Colorado River Lower Basin's water use may be forecasted to exceed the 7.5 million acre-foot limit. If further emergency water conservation measures are requested, the flooding/leaching program can be implemented on a mandatory basis to reduce water use.

Based on the pilot studies that have been conducted in IID, it has been estimated that the modified alfalfa irrigation, and flooding/leaching programs can reduce water use by 1.36 acre-feet/acre, and 0.3 acre-feet/acre respectively. A water use reduction estimate for the land fallowing program has not yet been determined and will be estimated based on the water use history of the lands in the Test Water Conservation Program. A mean water use reduction estimate will be developed once a test program has been implemented.

It must be recognized that long-term implementation of these programs may produce adverse effects to soil and crop productivity in subsequent years. Therefore, the timing of individual or combined programs becomes crucial for the optimal success of the overall program. The risk of long-term adverse effects to soil and crop productivity should be recognized through appropriate compensation.

IID and the participating farmers will need to be compensated for all costs incurred by implementation of the water conservation contingency programs if an agency other than IID is the program beneficiary.

20-146

IRRIGATION SCHEDULING WITH THE NEUTRON PROBE

Douglas G. Welch Jr.*

Denise A. Granahan**

ABSTRACT

In 1981 the Imperial Irrigation District (District) in cooperation with the United States Bureau of Reclamation started a demonstration irrigation scheduling program on 15,000 acres (6,075 ha). Neutron probes were used to monitor soil moisture and schedule irrigations. Water level recorders were used to measure delivery and tailwater. The irrigation scheduling program is part of a larger four year study, Water Conservation Opportunities, Imperial Irrigation District, in which the Bureau of Reclamation estimates potential on-farm water conservation opportunities of 125,000 acre-feet (154,250 cubic dekameters). Predicting irrigation dates and the amount of water to be applied has improved irrigation efficiency on many of the fields in the program. Irrigation scheduling using the neutron probe has proven to be an effective way to conserve water.

Introduction

The purpose of the Bureau of Reclamation's study was to identify areas of potential water savings in the District, determine whether future detailed studies were justified that could lead to recommendations for Reclamation project development, and identify other opportunities that the District and irrigators could consider. Alternative structural and nonstructural water conservation measures needed to be evaluated, considering existing District irrigation facilities, operations, and practices, to determine the potential for conserving water currently entering the Salton Sea. Conserved water could be used to meet future water needs.

* Supervisor, Water Conservation, Imperial Irrigation District, Imperial, CA

** Water Conservation Specialist, Imperial Irrigation District, Imperial, CA

The Imperial Irrigation District is a public corporation organized in 1911 under the California Irrigation District Act. The District's irrigation service area of 1,062,290 acres (430,227 ha) is divided into the East Mesa, Imperial, Pilot Knob, and West Mesa Units. Only the Imperial Unit has been developed and about 458,000 acres (185,490 ha) of the 694,400 acres in the unit are normally irrigated.

The District operates and maintains the Imperial Dam, the 80-mile (129 km) All-American Canal, 1,625 miles (2,616 km) of other canals and laterals (approximately 840 miles have been concrete lined cooperatively by irrigators and the District), four small regulating reservoirs, and all associated diversion and control structures.

Annually an average of 2.8 million acre-feet (3.46 million cubic dekameters) of water is diverted from the Colorado River (the District's only source of water) at Imperial Dam, just north of Yuma, Arizona.

It has been determined that Colorado River flows are inadequate to meet present and future agricultural, municipal and industrial needs in southern California. After completion of the Central Arizona Project, Metropolitan Water District's allotment will be reduced to 550,000 acre-feet (678,700 cubic dekameters). If water could be saved in the Imperial Valley, conserved or surplus water, which is a portion of District water appropriated pursuant to state law, could be used outside of the District boundaries if the District's Board of Directors finds it to be in the best interest of the District.

This paper addresses the potential on-farm water savings possible through improved irrigation scheduling.

Potential For Water Conservation

Irrigation water management means different things to different people. In general it involves managing water to get the desired results with minimum waste, at a reasonable cost, and with a minimum of adverse effects. The potential exists for water conservation in the Imperial Valley for all types of irrigation systems. All systems should be managed as efficiently as practical. The overall unit irrigation efficiency for the Imperial Valley is potentially 90-95 percent. The present unit efficiency is estimated by the District to be 83 percent, but ranges from 60 percent to 100 percent on individual fields. The District estimates that an improvement of 5 to 10 percent in the unit irrigation efficiency in the Imperial Valley is possible.

Demonstration Irrigation Scheduling Program

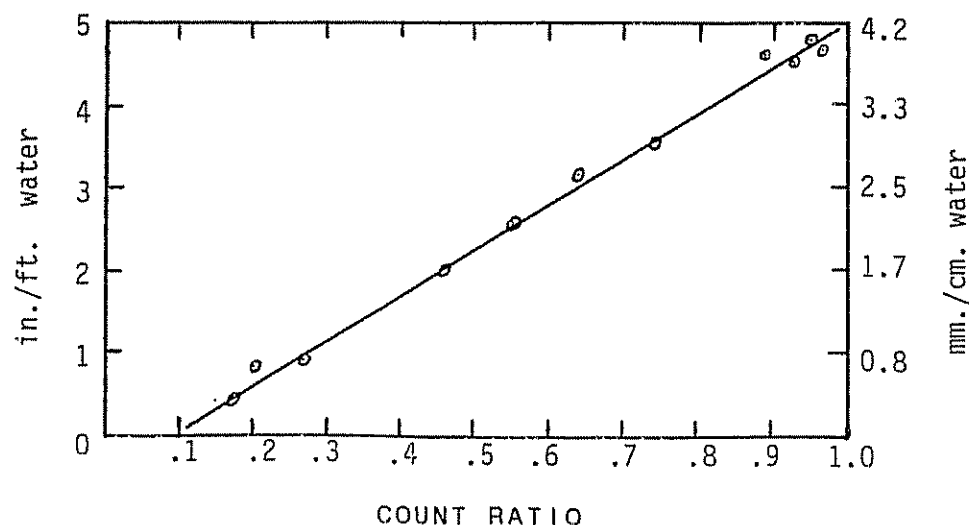
In 1981 the Imperial Irrigation District, in cooperation with the United States Bureau of Reclamation, started a demonstration irrigation scheduling program on 15,000 acres (6,075 ha) of irrigated land. Neutron probes were used to monitor soil moisture and schedule irrigations. Water level recorders were used to measure delivery water and tailwater. The neutron probe can be used to take quick accurate measurements of soil moisture. It has proven to be a reliable tool for taking direct measurements of soil moisture without disturbing the site, after the initial installation of the access tube. Irrigation recommendations can be made quickly without using all the computations that are necessary in other methods such as the water budget method.

Calibration Of The Neutron Probe

The neutron probe must be calibrated so that the readings can be related to soil moisture content. An access tube is installed in the field and readings are taken at different depths. Soil samples are collected concurrently adjacent to the access tube and are gravimetrically analyzed to determine the soil moisture content. This data is then plotted on a graph (see figure 1). A best-fit straight line is fitted through these points, which then can be used to determine field soil moisture content at any depth with a 30 second count of the probe. For the purposes of irrigation scheduling it has been empirically determined that one calibration curve is normally sufficient for scheduling on Imperial Valley soils.

FIGURE 1

NEUTRON PROBE CALIBRATION CURVE



Monitoring Soil Moisture Depletion

The site is located in an area where plant growth is representative of the majority of the field. Usually one tube is installed per field in flat crops and two (head and tail of the field) in row crops. Where needed more tubes are installed.

Readings are taken at three depths; 6 inches, 18 inches, and 30 inches (152, 457, and 762 mm). After the first irrigation, the field capacity in the active root zone is determined. Additional readings are taken between irrigations to determine the amount of water in the soil. A minimum of two readings, preferably just after and just before the scheduled irrigation, are necessary.

Scheduling Irrigations

Soils will hold only a certain amount of water that is available for plant use. Management allowed deficiency (MAD) is the average allowable deficiency of available soil moisture in the crop root zone, when an irrigation is scheduled. MAD is established based on factors such as crop, stage of growth, soil, climate, water quality, soil salinity, labor and water availability. MAD can be expressed in percent depletion of the total available moisture below field capacity or in inches of water depleted. An estimate of the available water holding capacity of the soil, the rooting depth, and the selected MAD for the crop must be made, before an irrigation is scheduled.

TABLE 1

AVAILABLE WATER HOLDING CAPACITY

Soil Texture	Average in./ft.	Average mm/cm
Very Coarse To Coarse Textured Sand	0.80	0.66
Moderately Coarse Textured Sandy Loams and Fine Sandy Loams	1.20	1.00
Medium Texture - Very Fine Sandy Loams to Silty Clay Loam	2.00	1.67
Fine and Very Fine Texture - Silty Clay to Clay	1.80	1.50

The range of the available water holding capacity, AWC, for different soil textures is listed in table 1. This is the amount of water available for plant use between field

capacity and wilting point. The AWC is equal to the AWC value corresponding to the soil texture for each foot of depth. This is the AWC for the specific site for a specific crop rooting depth.

The amount of moisture available to the plant is affected by soil salinity. Table 2 lists the reduction in soil AWC due to salinity. When establishing the MAD, reduction of available moisture must be considered. Table 3 gives some guidance in selecting MAD. These are general guidelines and are modified for crop stage, soils, weather and salinity. Once the MAD level is determined for a field, scheduling can begin.

TABLE 2

REDUCTION IN AVAILABLE WATER CAPACITY (AWC) OF SOILS DUE TO SALINITY AS MEASURED IN THE SOIL SATURATION EXTRACT

EC (mmhos/cm)	4	8	12	15	20	25	30	35
percent reduction in AWC	10	20	30	40	60	80	90	95

TABLE 3

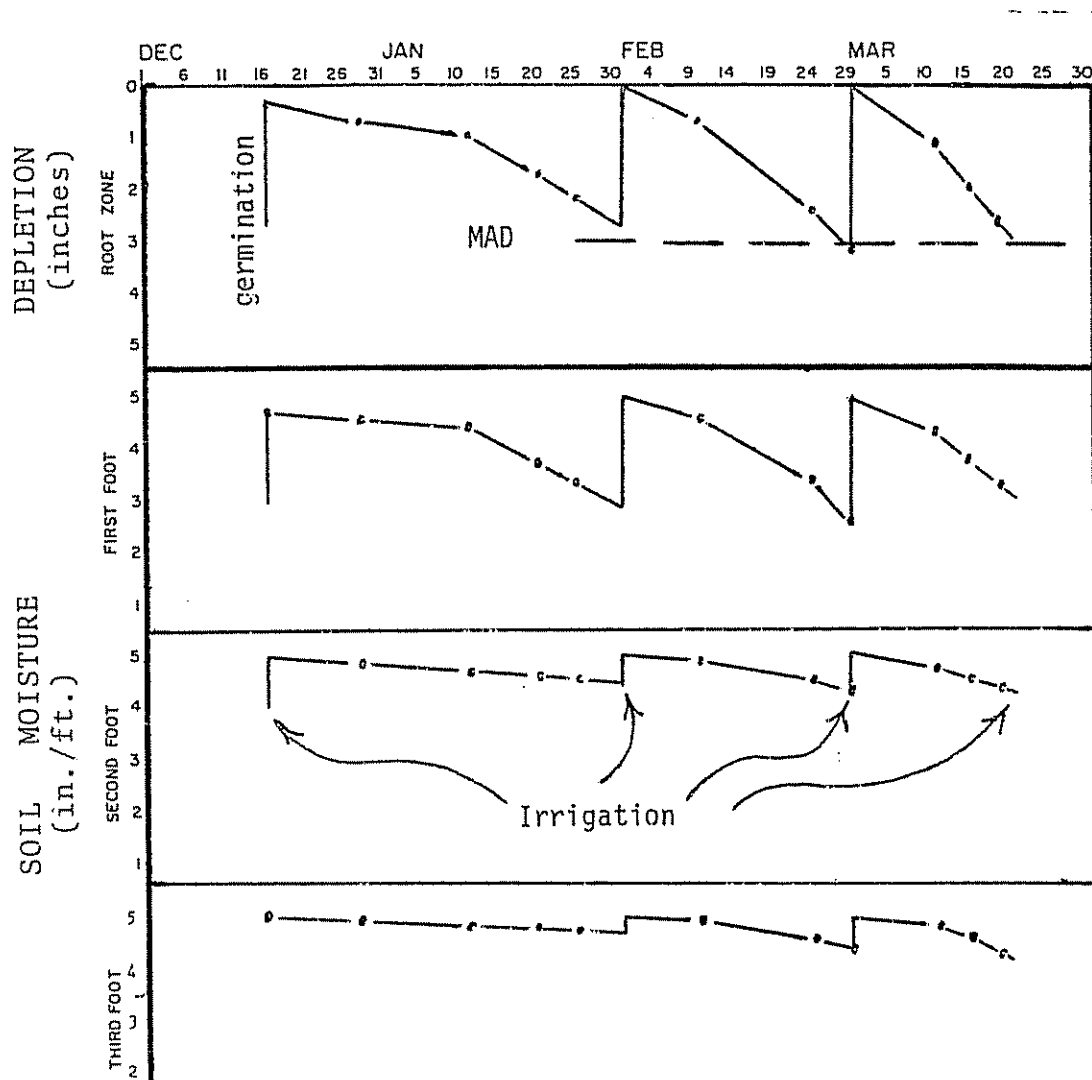
RECOMMENDED VALUES OF MAD BEFORE ADJUSTMENTS FOR LOCAL CONDITIONS:

<u>Root Depth</u>	<u>Crop Harvested</u>	<u>Average Percentage MAD in Rootzone</u>
Shallow (2-3 ft.)	Succulent crops, harvested for the plant	45
Shallow	Fibrous crops	55
Moderate (3-5 ft.)	Perennial crops	58
Moderate	Annual crops	60
Deep (> 5 ft.)	Perennial, succulent fruit	65
Deep	Perennial	70

Moisture in the root zone is monitored twice weekly during the summer and weekly during the winter with the neutron probe and converted to soil moisture depletion. After each visit to a field the soil moisture data is given to the grower. This data is plotted versus time on a graph (see figure 2). Irrigation dates and the net irrigation requirements are predicted by extending a straight line through the last two moisture data points and noting where

it intersects the MAD curve. The date of the predicted irrigation is read from the time axis. The net irrigation requirement is read from the soil moisture depletion axis. The soil moisture log for a 72 acre (29 ha) wheat field monitored in 1984 is shown in figure 2. Readings were taken on March 1st, 9th and 15th. These readings are plotted in inches water per foot of soil.

FIGURE 2
SOIL MOISTURE LOG



Gross Irrigation Application = $\frac{3.0 \text{ inches}}{0.75} = 4.0 \text{ inches}$

Water is delivered in 24 hour increments in the District, therefore 12 cfs for 24 hours was recommended.

$$\frac{4 \text{ in} \times 72 \text{ acres}}{24 \text{ hrs}} = 12 \text{ cfs}$$

The three readings in the root zone are added together and then subtracted from the field capacity to arrive at the soil moisture depletion in the root zone which is then plotted on the corresponding date. A straight line is extended through the last two data points and noting where it intersects MAD, the date of the projected irrigation is read from the time axis. MAD was set at 50 percent, or 3 inches (762 mm) depletion of 6 inches (152 mm) AWC in the effective root zone. The application efficiency was estimated to be 75 percent (15 percent allowed for leaching and 10 percent for tailwater). A 4 inch (102 mm) application on March 21, 1984 was recommended.

The field was irrigated on March 21, 1984. Delivery was measured, 24.4 acre-feet (30.1 cubic dekameters), with a water level recorder over a broad-crested weir. Tailwater was measured, 2.4 acre feet (3.0 cubic dekameters), with a District Standard Tailwater Structure (suppressed rectangular weir). Assuming that all of the deep percolation was required to maintain the salinity level in the root zone, the unit irrigation efficiency for the irrigation was 90 percent.

RESULTS

The neutron probe has proven to be a simple but accurate method for monitoring soil moisture and scheduling irrigations. A majority of the farmers participating in the program have reduced their tailwater. On wheat fields where previously 10 to 12 irrigations were being applied in a season, 5 to 7 irrigations are now being applied.

On the average two irrigations can be eliminated on wheat fields, which is a \$2.80 per acre labor savings. Approximately 0.125 acre-feet per acre (0.154 cubic dekameters per ha) less water will be applied to the field, resulting in a savings of \$1.13 per acre. The total savings would be \$3.93 per acre. The estimated cost for the scheduling service is \$3 per acre.

Similar savings have been achieved on other crops in the irrigation scheduling program.

As a supplement to the scheduling program, a small irrigation training program was implemented in 1983. Several farmers and irrigators were trained to observe and record the stream advance and quantity of tailwater in border-strip irrigation. Adjustments were then made during the irrigation to reduce the quantity of tailwater. Unit irrigation efficiencies of 90 to 95 percent were achieved during the training period. Previously, unit efficiencies of 70 to 75 percent had been monitored. During 1984 these fields were monitored and unit efficiencies increased to 85 to 95 percent.

SUMMARY

Water savings in the District's neutron probe irrigation scheduling program appear to be approximately 0.125 acre-feet per acre (0.154 cubic dekameters per ha). If implemented District wide, savings would be approximately 57,000 acre-feet (70,338 ha).

If other programs and improvements, such as irrigation training, improved land-leveling, on-farm irrigation system automation, and tailwater return systems were implemented, tailwater could realistically be reduced to five percent, conserving 220,000 acre-feet (271,480 ha) of water.

It should be noted that the costs to conserve the aforementioned water, have been estimated to range between \$3 and \$125 per acre-foot. One can see why Imperial Valley farmers, paying \$9 per acre-foot, have not implemented some of the more expensive methods to conserve water which are not cost effective on-farm. The District is presently negotiating with Metropolitan Water District and other interested parties to obtain funds for water conservation projects, both in the District's system and on-farm. Water conserved could then be transferred to the party funding the conservation project.

References

- (1) "Imperial Irrigation District, Water Conservation Plan, Draft, January 31, 1985" pp. 11.1 - 111.12
- (2) Dickey, Gyland L., "Irrigation Scheduling Based on Management Allowed Soil Moisture Deficiency", unpublished paper. pp. 1 - 13

20-147

Publication: FARM WATER WATCH (CVWD)
Date: SPRING 1994

Section/Page 6

IID abruptly ends joint water efficiency study

A joint water efficiency study on lands irrigated by Colorado River water in Imperial Irrigation District and Coachella Valley Water District was abruptly ended by IID officials recently when they refused to participate in on-farm studies within their service area.

IID, CVWD and the Bureau of Reclamation were joint participants in the study which was being conducted by the country's leading experts in irrigation efficiency.

Bureau officials sought the joint study to develop impartial information which could be applied to improve water use efficiency for the over-committed Colorado River.

The development of impartial information was important after IID paid Boyle Engineering to create back-to-back papers. The first accused Coachella Valley farmers of being only 57 percent efficient in their water use and the second praised Imperial Valley farmers for being 83 percent efficient. Different formulas for determining on-farm efficiencies were used in the two reports.

In a letter to Charles Shreves, IID general manager, bureau acting regional director Robert W. Johnson states:

"... We regret that we have been unable to jointly complete the water use assessment. Even if the agreement accommodated your latest proposal, we are concerned that Reclamation and IID would be unable to agree on an acceptable plan.

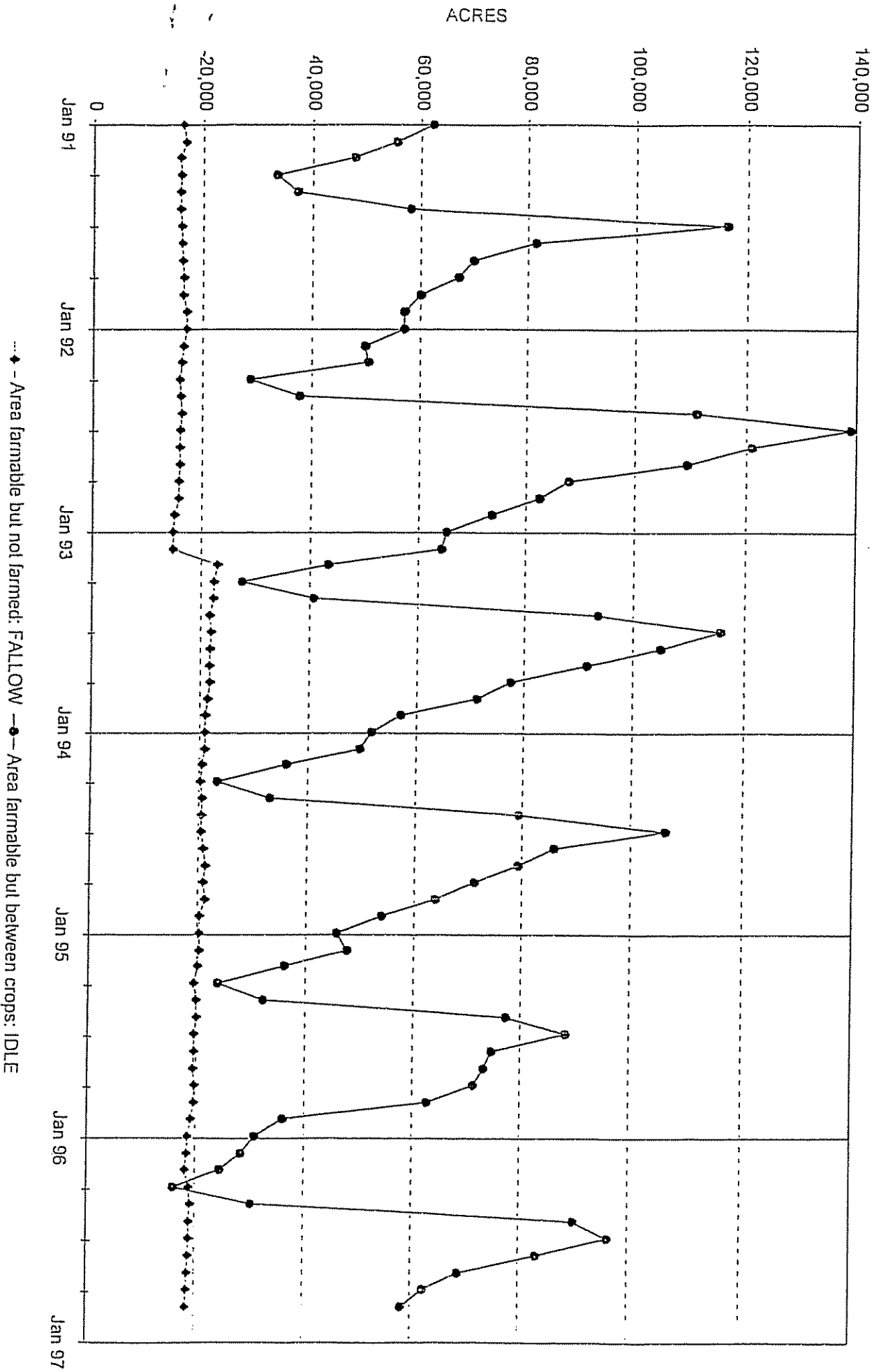
"... Although the desired outcomes of the agreement were not achieved, Reclamation still has responsibility to implement Federal (regulations dealing with reasonable and beneficial consumptive use). It is our intent, therefore, to pursue the study objectives independently. We will keep you informed of our plan for meeting those objectives as it develops."

Imperial Irrigation District officials have claimed an ultimate need for more water than their farmers have taken historically. A key provision in Colorado River water diversions requires the water be put to reasonable and beneficial consumptive use.

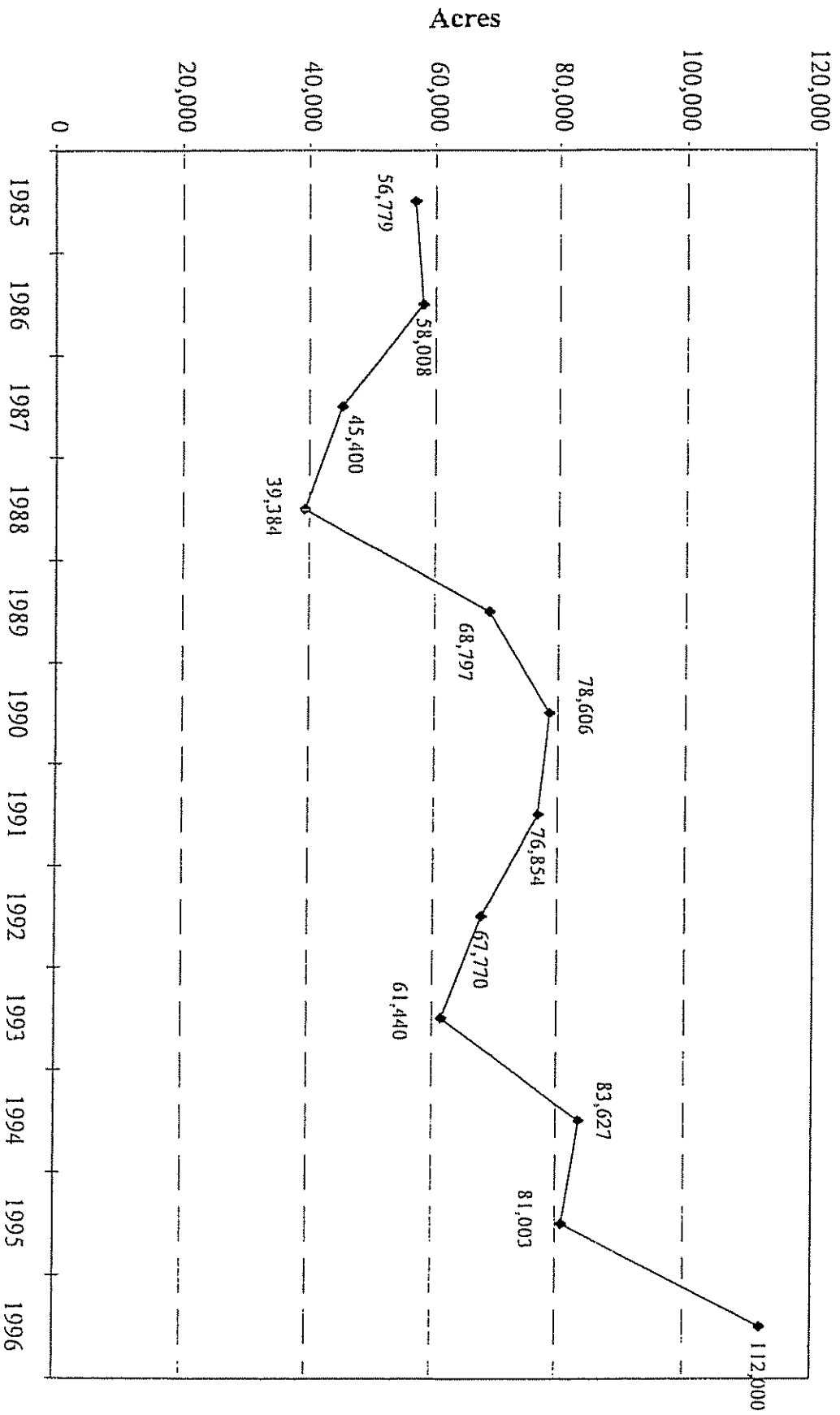
AG 3

20-148

FALLOW and IDLE ACREAGE 1991 - 1996



Duplicate Crop Acreage

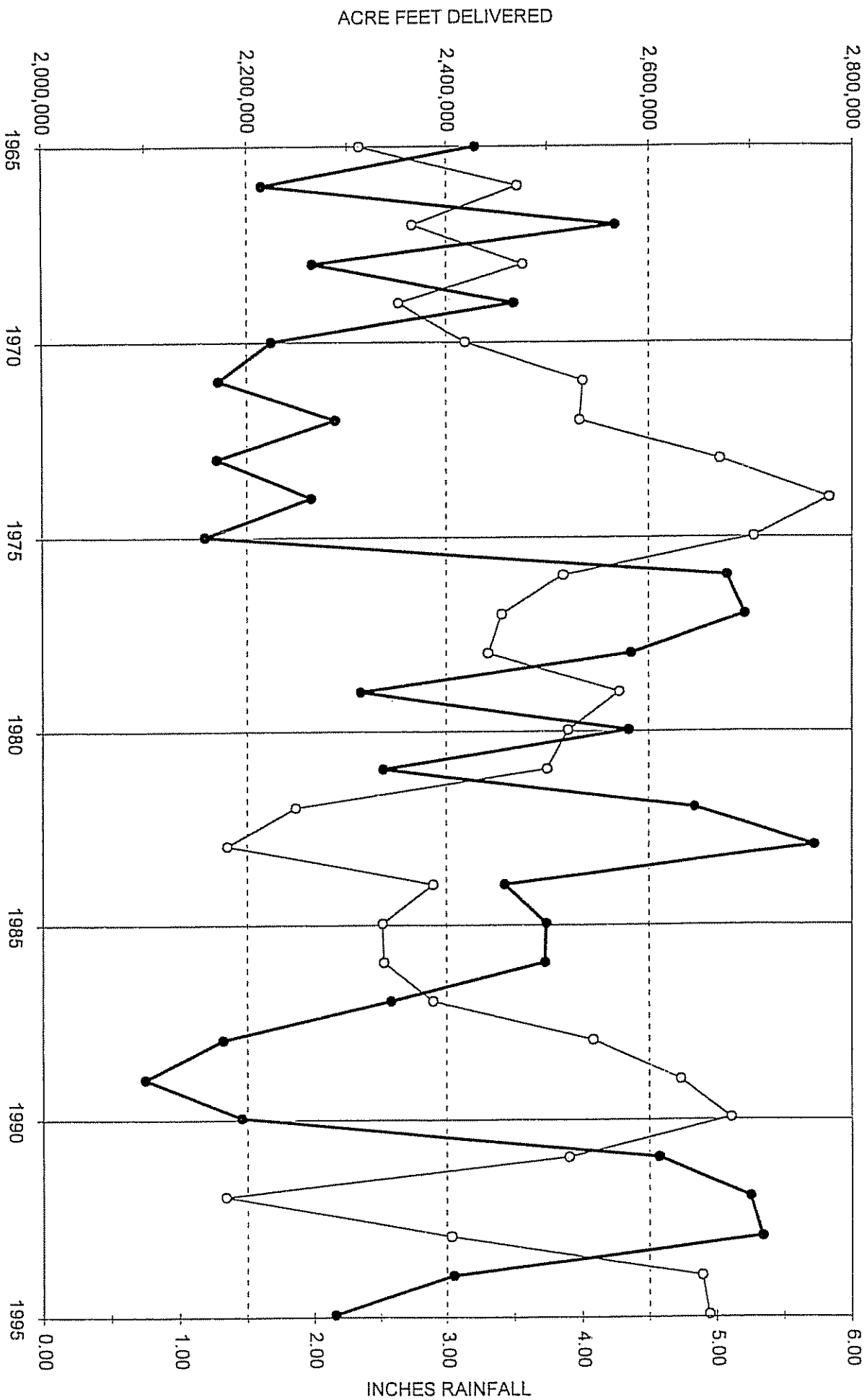


ACRE FEET DELIVERED and RAINFALL

ANNUAL

1965 - 1995

—○— DELIVERED TO USERS (AC-FT) —●— RAINFALL IN INCHES



20-149

FAKED
333-9212

JPM

JOHN ECKHART

DESERT FARM & RANCH, Wednesday, June 16, 1999

IMPERIAL COUNTY PAGE

Project saves runoff water, but farmers question effectiveness

By JOYCE CHRISTIE
Desert Farm & Ranch Editor

HOLTVILLE — A three-year alfalfa project demonstrated that water can be saved and runoff reduced without making costly modifications to the irrigation system, Imperial Valley farmers were told during a recent two-day Irrigation Management and Surface Runoff Reduction Conference.

"This can be done with simple timing," said Khaled Ball, Imperial County Cooperative Extension adviser who conducted the project in cooperation with Imperial Irrigation District, U.S. Bureau of Reclamation and California Department of Water Resources.

He said the secret is to know when to cut off irrigation water and still have enough flow to cover the entire field but not have runoff. Spread sheets are available to help determine irrigation times by factoring in slope of the field, flow of the water and its speed as it advances.

Ball concluded that a water savings of 6 percent to 15 percent can be achieved without significant impact on the quality of the crop. There is some drop in yield at the end of the fields, an average of about 2 percent for the field, he said. However, he added, that much yield loss is seen with conventional flood

irrigation because part of the crop is standing in excess water.

Some farmers at the conference were unimpressed with Ball's work, questioning its effectiveness in the real world of farming on large blocks of land with different soil types.

"Some say we shouldn't be farming in the desert. Should Los Angeles on the desert coast be an urban area?"

"It's far more difficult than looking at the tail box," said area grower Brad Luckey. "You have college people sticking with a small block of land and water they can control and they still have tail water."

Ball defended his work, saying he was looking for a simple and inexpensive way to conserve water.

Water conservation has become a major issue in the Imperial Valley as thirsty cities look to agricultural allocations for a source to keep their taps running. Amid allegations they're wasting water, Imperial farmers say they've done all they can without help.

"The valley has been scrutinized for years," Luckey said. "We're all much more water conscious than we were 10 years ago. We're trying to be as efficient as we can. We could do better but we need help."

If farmers reduce their water, salt builds up on their fields, he said. And whatever farmers do, some agency will be unhappy.

"If the USBR doesn't sue us for too much tail water," he said, "the Audubon Society duns us

for too little."

Fields in Imperial County tend to have heavier soils than in Yuma County and slope from the south to the north toward the Salton Sea, explained grower Mark Hamby. That results in agricultural runoff flowing into the sea and contaminating it with pesticides, salt and selenium. But the runoff also maintains the lake's level.

While Imperial Valley fields may be laser leveled, it would be too expensive to do away completely with this natural slope, Hamby said.

He is taking part in various pilot projects. One is a level basin project where he has installed a drip system.

The system cost \$600 an acre. It used considerably less water and did increase yields, he said, "but I didn't find it offset the cost. It's not for everyone or every place."

Pumpbacks are another idea being tried whereby runoff is captured and returned to the head gate, said David Bradshaw, head of a IID conservation unit. The reuse is resulting in considerable water savings but it may require costly improvements to the irrigation system.

Luckey said part of the problem is that two-thirds of California's water is in the northern part of the state while two-thirds of the people live in the southern part.

"Some say we shouldn't be farming in the desert," he said. "Should Los Angeles on the desert coast be an urban area? Coachella and all its golf courses ... is that a beneficial use of the water?"

20-150

JE

Imperial Irrigation District

Memo

To: Board of Directors
From: Brad Luckey – Executive Officer
CC: Jesse Silva, John Eckhardt and John Carter
Date: 03/27/00
Re: Khaled Bali project

As you will remember, Khaled Bali did a project out at Meloland to provide research on reduced irrigation runoff from alfalfa and sudan grass. The final report was issued recently and John Eckhardt and his staff did a great job technically shredding the report. I have drafted a letter to Mr. Reg Gomes, President of the University of California Division of Agriculture and Natural Resources, in an attempt to shelve this report on a permanent basis (copy attached). Please review this letter and provide me with your comments and/or if you feel sending this letter is appropriate from the IID. I feel very strongly that research such as done by Mr. Bali does not serve our constituents in any matter or form. I would like to send this letter as soon as possible so please advise me as to your direction.

*note: not sure if attached
letter was ever
sent - call Brad Luckey
to verify*

Brad



IMPERIAL IRRIGATION DISTRICT

EXECUTIVE OFFICER • 1284 MAIN STREET • EL CENTRO, CA 92243

March 27, 2000

Mr. Reg Gomes
President
Division of Agriculture and Natural Resources
University of California
1111 Franklin Street, 6th Floor
Oakland, CA 94607-5200

Dear Mr. Gomes,

It has been awhile since I saw you last. I am a member of the Advisory Board for the Joint Policy Council but I have been unable to attend the last few meetings due to a change in jobs. As you can see from the letterhead I am no longer farming and am now working for the Imperial Irrigation District. It is in that position I find myself writing this letter to you. A few weeks ago a copy of the draft final report entitled- Irrigation and Drainage Management and Surface Runoff Reduction in the Imperial Valley came across my desk. As a member of the Research Advisory Committee (RAC) for the UC Desert Research and Extension Center (UCDREC) I had heard about this very controversial project conducted by Khaled M. Bali, Mark E. Grismer and Richard L. Snyder. Mr. Bali is a farm advisor with Cooperative Extension stationed at UCDREC and Mr. Grismer and Mr. Snyder are from UC Davis. This project was a three-year study to document the effects on alfalfa and sudan grass production by eliminating surface runoff. It was funded by the California Department of Water Resources, the Bureau of Reclamation and the Imperial Irrigation District. I have enclosed a copy of the Executive Summary, which will give you a brief background on this project.

The reason I have written this letter is to express to you my concerns about the manner in which the scientific protocols were handled and the possible long term negative effects it could impart on the reputation of research conducted by the University of California Co-operative Extension Service. In regards to protocol, the first problem was created when the salinity control tile lines were plugged in order to raise the ground water elevation. Irrigation water in Imperial Valley is delivered from the Colorado River and is very high in salt. Plugging the tile lines is not acceptable in production agriculture because in a very short time the soil would become too salty to produce crops. I feel the tile lines were plugged in order to raise the water table to help provide moisture from below which would reduce the need for water from above and skew the results of the study. Another problem is the fact that the entire lower 400 feet of this experimental plot had to be totally replanted as the crop of alfalfa died from lack of water. The billing records at DREC for tractor work done midway through this project will support this.

There are numerous other deficiencies woven throughout this project. If the purpose was to prove that alfalfa and sudan grass can be grown using less water without regard to economic and business protocol then it is a success. If it's intent was to educate and promote scientific research for application here in the Imperial Valley then it has failed. I know I have not gone into great

detail in this letter. I am hoping you will find what I have shared with you to be enough to look into this project in greater detail. I can provide you with a detailed technical review of this project by the water department manager of the Imperial Irrigation District if you so desire. Only through careful and meaningful research can the University of California retain its well-deserved reputation. Projects such as this one can serve no purpose, other than to cloud that image. Thank you for your attention in this regard.

Sincerely,

A handwritten signature in black ink that reads "Brad Luckey". The signature is written in a cursive, slightly slanted style.

Brad Luckey

DRAFT FOR DISCUSSION ONLY

Data presented in this report are preliminary and not for publication until authorized by the investigators – December 1999

Executive Summary:

Colorado River water is the lifeblood of the Imperial Valley as it is the only source of irrigation and drinking water in the Valley. As much as 2.8-3.0 million acre-feet (MAF) out of an recently agreed upon allotment of 3.1 MAF of Colorado River water are used every year to irrigate more than 500,000 acres of land in the Imperial Valley. Surface and subsurface drainage water from irrigated fields enter the Salton Sea, the drainage sink for the Imperial and Coachella Valleys since its formation in 1905. The Sea continues to exist because of agriculture drainage water from these Valleys as well as agricultural drainage and untreated and partially treated sewage from the Mexicali Valley. Because of drainage and its impact on the Sea, several water quality issues exist in the Imperial Valley in which water conservation plays a role.

This report describes the development of a new method to minimize or eliminate surface runoff (tailwater) from irrigated forage crops grown on heavy clay soils of the Imperial Valley. It also presents the best management practices (BMP's) to achieve the above objective and describes the demonstration project that was conducted at the University of California Desert Research & Extension Center (UCDREC) between 1995 and 1999 to evaluate the effectiveness of this new method.

An alluvial, moderately saline (EC^e 6-8 dS/m in the rootzone) clay soil at UCDREC, Holtville, CA, was cultivated and sudangrass was planted in April 1996, April 1997, and April 1998 (Field No. 1). Alfalfa was planted in November 1995 (Field No. 2) followed by a corn planting on the same ground in February 1999. A total of 15 acres were used in this project. The area was divided into 2 fields each containing separate plantings of alfalfa (followed by corn) and sudangrass. Each field contained 4 borders; each border was 65 ft wide and approximately 1250 ft long. Thirty-two sampling locations were established in each field to determine soil moisture, water table elevation and quality, and soil salinity at different depths. Moisture contents at all sampling locations were measured using a neutron probe. Soil moisture measurements were made prior to irrigation and 2 or 3 days after irrigation. Alfalfa and sudangrass hay yields were determined for every cutting.

Significant amount of runoff water was saved as a result of the implementation of this method. Overall only 2% of the applied water became runoff resulting in a significant increase in water application efficiency. Additional water savings were obtained by reducing the frequency of water application from two to one irrigation per alfalfa cutting cycle. The effect of reduced surface runoff irrigations on alfalfa yield was only minimal (less than 2% reduction). Sudangrass yield was not affected by the surface runoff reduction treatment and resulted in similar water savings. Alfalfa and sudangrass hay quality was not affected by the implementation of the runoff reduction method. We obtained average applied water use efficiencies (AWUE's) of 1.77 tons of sudangrass per ac-ft/ac and 1.76 dry tons of alfalfa per ac-ft/ac. The corresponding WUE (includes AW, rain and WT contributions to ET of the crop) figures for sudangrass and alfalfa were 1.75 and 1.54, respectively. This alfalfa AWUE value (i.e. 1.76) compared more favorably with the CA and AZ statewide (1998) average AWUE's of 1.80 and 1.49 dry tons of alfalfa per ac-ft/ac, respectively,

DRAFT FOR DISCUSSION ONLY

Data presented in this report are preliminary *and not for publication* until authorized by the investigators – December 1999
as compared to the Imperial Valley (1996-1998) average AWUE of 1.17 tons of alfalfa per ac-ft/ac.

We found that shutting off the applied water at when the surface wetting front reached approximately 70-75% of the field's length resulted in sufficient water coverage to irrigate the entire border while reducing runoff to only 1-6% of the applied water. For the first irrigation, a cutoff distance of approximately 80-85% of the field's length is recommended and adequate to ensure that enough water reaches the lower end of the field. The method of Grismer and Tod (1994) may be used to estimate the volume of cracks and cutoff distance or time in heavy soils for all irrigations after the first irrigation in the growing season.

Water table contribution (WTC) to alfalfa crop evapotranspiration was only significant during the first year of the study. Water table contribution accounted for approximately 18% of alfalfa crop water use during the first year of the study and only 11% during the entire alfalfa growing period (Nov. 95 through Aug. 98). The average alfalfa crop coefficient for the entire alfalfa growing period was approximately 0.84. After three years, the average crop coefficient for sudangrass during the entire growing seasons was approximately 0.81.

An increase in soil salinity of the alfalfa field was observed as a result of the upward movement of water from the saline water table. However, soil salinity levels after leaching and planting a salt sensitive crop (sweet corn) were at or below salinity levels at the beginning of the experiment. Soil salinity in the sudangrass field did not increase as a result of the implementation of the runoff reduction method.

Additional work is needed to verify the applicability of this method to commercial fields and under conditions where irrigation water deliveries are set for either 12 or 24-hour orders as is common in the Imperial Valley.

20-151



IMPERIAL IRRIGATION DISTRICT



OPERATING HEADQUARTERS • P O BOX 937 • IMPERIAL, CALIFORNIA 92251

February 28, 2000

Dr. Khaled M. Bali,
Farm Advisor, Irrigation/Water Management
University of California Cooperative Extension
1050 E. Holton Road
Holtville, CA 92250-9615

Re: Draft final report, Contract No. B-80560: Irrigation and Drainage Management
and Surface runoff Reduction in the Imperial Valley Project

Dear Dr. Bali,

Thank you for providing us with the opportunity to review and comment on your report.
Comments by IID staff are attached.

Sincerely,

John Eckhardt, Ph.D., P.E.
Manager, Water Department

cc: Dr. Baryohay Davidoff, DWR
Mr. Wayne Verrill, DWR
Mr. Steve Jones, USBR
Ms. Lauren Grizzle, Imperial Valley Farm Bureau



IMPERIAL IRRIGATION DISTRICT

OPERATING HEADQUARTERS • P. O. BOX 937 • IMPERIAL, CALIFORNIA 92251

February 28, 2000

WD-WRU ✓
WD-RMS _____
WD _____

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TECHINICAL REVIEW

Irrigation and Drainage Management and Surface Runoff Reduction in the Imperial Valley, DRAFT FINAL REPORT, Bali, et. al., December 1999

Executive Summary

1. The reference in the Executive Summary that, "This report describes the development of a new method to minimize runoff . . ." is hardly accurate. The practice of under-irrigating crops to extend water resources in areas where water is in short supply has been in existence for centuries around the world.

SECTION I *Best Management Practices*

2. Dr. Bali should accurately and completely describe the irrigation system used in his runoff reduction research. Pumping a constant rate from a field reservoir during daylight hours is not typical of surface water irrigation from an open channel canal system in the Imperial Valley. Dr. Bali's research plots experienced none of the head and flow variation inherent in an open channel canal system operated at maximum flexibility. Dr. Bali was able to start his pump when he was ready to irrigate, not necessarily at the Meloland Station's regular turn time. Dr. Bali was able to turn off his pump and end his irrigation events at the precise time he was finished applying water. He did not first have to notify IID for an early shut off and then wait for a *zanjero* (who is responsible for four canals and over 90 gates) to find the time to accommodate his request. Rather than focusing on a cutback irrigation scheme that, at best, might have limited applicability, perhaps the strongest conclusion that should have been drawn from Dr. Bali's research is the potential benefit of small on-farm and/or mid-lateral reservoirs.

3. Both those who believe that Dr. Bali's work should form the basis of a new irrigation paradigm in the Imperial Valley and those who believe that his work on this project has been flawed should note that a single research project at a state-run experimental station seldom translates into widely adaptable technology. The adoption of technological innovations in agriculture tend to follow a standard model. The wide spread applicability of promising field station research is evaluated across multiple conditions through on-farm demonstration projects. If shown to be applicable across a range of conditions a given technology is adopted over time as it gains acceptance and wider use. Promotion may decrease the time required from introduction to widespread acceptance. Dr. Bali and those who believe that his research should gain immediate acceptance and adoption should refer to *Communication of Innovations* (Rogers and Shoemaker, Collier-MacMillan, 1971) for a better understanding of the process of technology transfer. As I am sure Dr. Bali realizes, promotion of a research innovation before it has demonstrated widespread applicability can kill what may otherwise be a promising ideal. I am sure Dr. Bali also realizes that research with limited applicability will not be adopted regardless of the effort put into its promotion.

4. Having stated the importance of an on-farm demonstration program to the successful dissemination and adoption of agricultural research, Dr. Bali and those who believe that his research should be immediately adopted need to realize that conducting or funding such a program is not the responsibility of the Imperial Irrigation District. Dr. Bali and the UC Cooperative

Extension Service need to identify both cooperating water users and funding. Dr. Bali may wish to consult with his Extension counterparts in Texas concerning their extensive and well-respected on-farm demonstration program which is funded entirely by growers, commodity groups, seed companies, fertilizer and pesticide manufacturers, food processors, irrigation equipment suppliers, and private foundations.

Section II Summary of Field Trials

In general, Section II is greatly lacking in substantive material to support many of the claims promoted in the conclusion. IID has commented previously on many of the reports prepared by Dr. Bali for this project. Likewise, IID and the farm community have continually objected to many of the overly zealous conclusions presented by Dr. Bali. Most pressing are the following:

1. No Scientific Control: The report compares all data gathered in the study to "average values" of sudangrass and alfalfa in the Imperial Valley rather than to a scientific control plot. The lack of a control for comparison purposes is a serious flaw in the study.
2. Soil Type: Section 4.1 Soil Type and Page 33, Paragraph 2: All reference to soil 115 Glenbar silty clay loam should be changed to Imperial-Glenbar silty clay loam. The soil series should be accurately named, although the IID and the NRCS have continually maintained that the soil depicted as an Imperial-Glenbar in the study area is actually closer to a Holtville soil series.

The Imperial-Glenbar soil does not contain a sand lens at the 60-inch depth, as was observed in test pits at the station in the test site area. For Dr. Bali to continually state that the soil in the study area is typical of heavy clay soils in the Valley is misleading and incorrect. The reference used to substantiate this is Zimmerman (1981), see page 32. If one looks in *Section 7 References* in the report, you see this reference is nothing more than an overlay of the SCS Soil Survey for the field station, and the NRCS has maintained that the soil may have been wrongly mapped. Even the soil survey has an accuracy of +/- 10 acres.

Regardless, the soil survey states that Imperial-Glenbar is not well suited to growing alfalfa due to the heaving of the taproot from the soil's shrink-swell action. The fact that the study site seems to grow alfalfa well is another indication that this soil is misdiagnosed in the report.

3. Root Depth: No data is given for sudangrass root development. This needs to be included.
4. Crop Coefficients and Water Table Contribution: Statement on page 46, "The average crop coefficient ((Applied Water, AW + rain + water table contribution, WTC)/ETo) for the entire growing season was 0.84." The reader cannot tell from this formulation whether the crop coefficient or the water table contribution was the independent variable. Indicate how the crop coefficients and how water table contribution were determined.
5. Irrigation Scheduling: Explain how the Water Table Contribution was taken into account in determining when to irrigate and how much to apply, see also Points 6 and 10 below.

6. Water Table Contribution: Add a column indicating Water Table Contribution (WTC) for each irrigation period to Tables 9-11 for Sudangrass irrigation and Table 22 Irrigation information – Alfalfa field. Due to the soil characteristics of the UCDREC study areas, the water table contribution (WTC) is not representative of almost any other Imperial Valley field. Both 18% and 11% are very high.

7. Tailwater Runoff: The average runoff of 2% is not that unusual for sandy fields. This is a clay soil, but lies over a sandy lens below. David Bradshaw of IID's Irrigation Management Unit has pictures provided to him by Dr. Bali that illustrate this. The potential for the water to run to the groundwater may be a major contributor to the low tailwater, and may greatly impact the point in the field at which the irrigation has to be terminated to achieve the results indicated by Dr. Bali.

8. Soil Moisture Depletion: Both study test sites (area 70 and area 80) have soils with similar water holding capacities, see Table 11, page 32. According to Table 11, the available water is 0.2 in/in for depths of 0" to 48" in both areas. As can be seen from Fig. 50, the average root zone for the alfalfa is 30 inches. Thus, by simple math, the available water to the crop is 0.2 in/in times 30 inches = 6 inches total.

The study gives the Kc values for sudangrass as 0.81 and for alfalfa as 0.84. We know that $ET_o \times K_c = ET_c$. If you multiply the ET_o listed in the Table 14 *Irrigation information (sudangrass field) - 1996*, column 3, *ET_o since previous irrigation*, by the Kc for sudangrass, you derive the ET_c since the last irrigation. ET_c is the amount of water the crop would transpire since the last irrigation. Finally, the footnote for Table 11, page 32 states, *Allowable depletion: 50% for most crops, 50-65% for crops that are relatively insensitive to water stress*. Based on these facts and assuming that the sudangrass in the study area had a root depth of 30 inches, we find that the soil stores only 6 inches of water.

Thus, disregarding water table contribution (WTC), plant stress would occur once the crop had extracted 65% of 6 inches or at 3.9 inches, or 65% moisture depletion. From Dr. Bali's data, we can determine that even if the soil were to be at field capacity (6" of available moisture in 30" root zone), the moisture depletion levels exceed the stress soil moisture depletion level at which wilting occurs. This can be seen from the following:

After Table 14, p. 35, **Sudangrass irrigation – 1996 season**. $K_c = 0.81$, $ET_c = K_c \times ET_o$, 30" soil profile with 6" Available Water, i.e., Moisture Depletion = $ET_c/6"$

Since Last Irrigation		
ET _o (in)	ET _c (in)	Moisture Depletion (%)
Pre-irrigation		
5.04	4.08	68%
7.57	6.13	102%
11.51	9.32	155%
7.87	6.37	106%
8.43	6.83	114%
7.40	5.99	100%

Thus, if the root zone were at field capacity after each irrigation, soil moisture availability prior to the next irrigation on the study sudangrass field would represent moisture depletion levels of 68%, 102%, 155%, 106%, 114%, and 100%. These are all above the allowable 65%.

Alfalfa stress also occurs at 65% depletion, 3.9 inches for a 30" root zone in soil types found in the study area. When values for ETo (in) since previous irrigation are multiplied by the Kc of 0.84, most resultant values are in the wilting point range for alfalfa. Especially look at the dates 9/10/96 and 11/1/96 where ETo is 11.11 inches and 10.75 inches, respectively. That is a moisture depletion of $[(0.81 \times 11.11)/6] \times 100 = 150\%$.

After Table 22, page 43, **Alfalfa irrigation**, $K_c = 0.84$, $ET_c = K_c \times ETo$,
30" soil profile with 6" Available Water, Moisture Depletion = $ET_c/6$ "

Date	Since Last Irrigation		
	ETo (in)	ETc (in)	Moisture Depletion (%)
12/4/95	2.5	2.10	35%
1/22/96	3.64	3.06	51%
3/19/96	7.65	6.43	107%
4/24/96	9.46	7.95	132%
5/17/96	7.59	6.38	106%
6/7/96	7.16	6.01	100%
7/3/96	8.61	7.23	121%
8/2/96	9.23	7.75	129%
9/10/96	11.11	9.33	156%
11/1/96	10.75	9.03	151%
12/20/96	4.38	3.68	61%
2/19/97	5.9	4.96	83%
4/7/97	9.29	7.80	130%
4/28/97	5.91	4.96	83%
5/19/97	5.88	4.94	82%
6/16/97	8.75	7.35	123%
7/11/97	8.46	7.11	118%
7/23/97	3.2	2.69	45%
8/8/97	4.85	4.07	68%
8/19/97	3.08	2.59	43%
9/5/97	4.13	3.47	58%
10/18/97	8.45	7.10	118%
11/14/97	3.68	3.09	52%
2/13/98	6.89	5.79	96%
3/20/98	4.77	4.01	67%
4/17/98	5.77	4.85	81%
4/29/98	3.20	2.69	45%
5/15/98	4.42	3.71	62%
5/27/98	3.24	2.72	45%
6/12/98	3.63	3.05	51%
6/26/98	5.76	4.84	81%
7/14/98	5.57	4.68	78%

In spite of these results, nowhere in the study is reference made to any plant stress or growth problems, much less a complete plant shutdown that would be expected for these types of soil moisture depletion levels in either sudangrass or alfalfa. In fact, yields are shown to be from 3.78% above the Imperial Valley farmers' average for sudangrass to 1% below the average for alfalfa.

9. Yield Impacts: From yield data provided in the paper, we see that study area yields for sudangrass exceeded average yields produced by Imperial Valley farmers in the first two years of the study; whereas, those for alfalfa exceeded those for the first year. Although, the last two years of alfalfa production were less than the valley average, as Dr. Bali indicates, the reduction in yield was less than 2%.

After Tables 10, p. 32 and 18-20, p. 38. Sudangrass yield (ton/ac), adjusted to 10% moisture

	Imperial Valley farmers		Study Area 70		Study -Valley Farmers	
Year	Area (ac)	Yield (ton/ac)	Area (ac)	Yield (ton/ac)	Yield (ton/ac)	Study-Farmers/Farmers
1995	77,365	6.50			--	--
1996	85,896	6.36	7.46	6.84	+0.48	+7.02%
1997	87,562	5.56	7.46	5.90	+0.34	+5.76%
1998	70,068	4.91	7.46	4.84	-0.07	-1.45%
Ave	80,223	5.83	7.46	5.86	+0.25	3.78%

After Tables 9, p. 32 and 21, p. 39. Alfalfa production (ton/ac), adjusted to 10% moisture

	Imperial Valley farmers		Study Area 70		Study -Valley Farmers	
Year	Area (ac)	Yield (ton/ac)	Area (ac)	Yield (ton/ac)	Yield (ton/ac)	Study-Farmers/Farmers
1995	182,401	7.88			--	--
1996	161,116	7.56	7.46	10.51	+2.95 ton/ac	28%
1997	165,922	7.56	7.46	6.59	-0.97 ton/ac	-15%
1998	178,517	7.65	7.46	6.62	-1.03 ton/ac	-16%
Ave	171,989	7.66	7.46	7.91	0.32	-1%

10. Water Table Contribution (WTC): With all of this, the conclusion of the study says that makeup water from the aquifer is only 11% to 18% (page 51). As can be seen from the table presented below, while the amount of water available to the crop over the entire season agrees with Dr. Bali's reporting, the water available to the crop root zone is not presented for the reader's consideration. Thus, concerns arise about plant stress and the real water table contribution.

From Dr. Bali's analysis we find that applied water for alfalfa was 149.28 inches, rain was 3.72 inches, and water table contribution was 17.57 inches -- around 11% (Table 22, p. 43 and Table 25, p 49). However, as can be seen from the table below, this calculation was based on the amount needed to meet crop ET (ETc). How it reaches the crop in a way to provide sufficient soil moisture to meet crop requirements is never indicated.

Therefore, as presented in this paper, Dr. Bali has not convinced the reader that the water table contribution was sufficient to meet the crop needs for available water without stress. Furthermore, as far as the reader can tell, ETc and WTC are dependent on each other, and Dr. Bali has not made clear how the value for either of them was obtained as an independent value.

After Table 22, p. 43. Alfalfa Irrigation – Water Table Contribution. Average crop coefficient ((AW+rain+water table contribution, WTC)/ETo) for the entire alfalfa growing season was 0.84.

Julian	Date	Rain since last irr (in)	WTC since last irr (in)		ETc since last irr (in)	Soil Moisture at time of irr	Alfalfa Irr (in)	Soil Moisture after irrigation (in)		Available Soil Moisture @ Stress
			.84 ETo -.75 ETo	Initial SM+ WTC +Rain	.84*ETo			SM @ irr +irr		
	11/8/95						3.91	3.91	3.91	2.1
	12/4/95	0	0.23	4.14	2.10	2.04	3.53	5.57	5.57	2.1
22	1/22/96	0.04	0.33	5.93	3.06	2.88	5.01	7.89	6.00	2.1
78	3/19/96	0.12	0.69	6.81	6.43	0.38	5.52	5.90	5.90	2.1
114	4/24/96	0	0.85	6.75	7.95	-1.19	6.13	4.94	4.94	2.1
137	5/17/96	0	0.68	5.62	6.38	-0.76	5.62	4.87	4.87	2.1
158	6/7/96	0	0.64	5.51	6.01	-0.51	4.99	4.49	4.49	2.1
184	7/3/96	0	0.77	5.26	7.23	-1.97	5.57	3.60	3.60	2.1
214	8/2/96	0	0.83	4.43	7.75	-3.33	5.49	2.17	2.17	2.1
253	9/10/96	0	1.00	3.16	9.33	-6.17	5.28	-0.89	-0.89	2.1
305	11/1/96	0	0.97	0.08	9.03	-8.95	5.30	-3.65	-3.65	2.1
355	12/20/96	0	0.39	-3.26	3.68	-6.94	4.19	-2.75	-2.75	2.1
415	2/19/97	0.32	0.53	-1.89	4.96	-6.85	4.37	-2.48	-2.48	2.1
462	4/7/97	0.12	0.84	-1.52	7.80	-9.33	4.65	-4.68	-4.68	2.1
483	4/28/97	0	0.53	-4.15	4.96	-9.11	4.66	-4.45	-4.45	2.1
504	5/19/97	0	0.53	-3.92	4.94	-8.86	4.57	-4.29	-4.29	2.1
532	6/16/97	0	0.79	-3.50	7.35	-10.85	4.47	-6.38	-6.38	2.1
557	7/11/97	0	0.76	-5.62	7.11	-12.73	5.27	-7.46	-7.46	2.1
569	7/23/97	0	0.29	-7.17	2.69	-9.86	1.42	-8.44	-8.44	2.1
585	8/8/97	0	0.44	-8.00	4.07	-12.08	4.80	-7.28	-7.28	2.1
596	8/19/97	0	0.28	-7.00	2.59	-9.59	1.79	-7.80	-7.80	2.1
613	9/5/97	0	0.37	-7.42	3.47	-10.89	4.59	-6.30	-6.30	2.1
656	10/18/97	1.18	0.76	-4.36	7.10	-11.46	4.60	-6.86	-6.86	2.1
683	11/14/97	0.00	0.33	-6.53	3.09	-9.62	3.40	-6.22	-6.22	2.1
773	2/13/98	1.19	0.62	-4.41	5.79	-10.20	4.58	-5.62	-5.62	2.1
808	3/20/98	0.59	0.43	-4.60	4.01	-8.61	4.60	-4.01	-4.01	2.1
836	4/17/98	0.16	0.52	-3.33	4.85	-8.17	5.15	-3.02	-3.02	2.1
848	4/29/98	0	0.29	-2.73	2.69	-5.42	3.24	-2.18	-2.18	2.1
864	5/15/98	0	0.40	-1.78	3.71	-5.50	4.39	-1.11	-1.11	2.1
876	5/27/98	0	0.29	-0.82	2.72	-3.54	3.87	0.33	0.33	2.1
892	6/12/98	0	0.33	0.66	3.05	-2.39	4.70	2.31	2.31	2.1
906	6/26/98	0	0.52	2.83	4.84	-2.01	4.55	2.54	2.54	2.1
924	7/14/98	0	0.50	3.04	4.68	-1.64	5.07	3.43	3.43	2.1
		3.72	17.72				149.3			
				ETc	165.40	13.8	AF			
				Rain+WTC+Irr	170.72	14.2	AF			
				Runoff (2%)	2.9856					
				Available Water	167.74	14.0	AF			

When Dr. Bali indicates the amount of Water Table Contribution since the previous irrigation event, this particular concern may be alleviated. However, Dr. Bali will have to be sure to indicate very clearly how the determination of the WTC was made.

On the other hand, from the presentation in this paper it is by no means clear that, aside from evaporation, water applied during the preparation irrigation in November was not stored in the soil (raising the water table level) and used by the crop once its root system developed. If this were the case, the water table contribution would be about the same (around 5 inches) in both years. Then the reason for reduced yield in the second year of the study would be under-irrigation. Presenting the water table contribution and yield data more specifically, will address this (unlikely) possibility, as well.

What needs to be done:

1. Indicate how either ETc or WTC was obtained as an independent value.
2. Indicate how the WTC would have been taken up in such a way as not to stress the crop. As can be seen from the table presented in Point 10, the model of $WTC = (0.84ETc - 0.75 ETo)$ which must be inferred from the statement on page 44 that indicates: $(AW + Rain)/ETo = 0.75$ (w/o WTC) 0.84 (including WTC) is not adequate to convince the reader of the author's argument.
3. Present in graphic form the soil moisture water balance, so the reader can see how water is being supplied to the root zone and used by the crop during the irrigation season. Point 2 relates to the crop water requirement of soil moisture of 3.9 inches or more to keep crop stress to a minimum.
4. The Yield and WUE values for the two borders that received the extra irrigation in 1997 as compared with the borders that did not receive extra irrigation (8% increase in AW, 27% to 31% yield increase) need to be provided. Dr. Bali should also indicate impact on the average yield for alfalfa irrigated using his recommended regime for that year.

Other Research, Analysis and Presentation Issues

1. Given the absence of a scientific control, Dr. Bali should make very clear what "average values" were used (yield and water application) to determine the current WUE values against which the study results were compared. Consider the following:

On page 31, Dr. Bali states, "According to UCCE guidelines ... approximately 6.5 ac-ft/ac of water are used annually on alfalfa. ... Approximately ½ ac-ft-ac of water is used for land preparation and approximately another ½ ac-ft/ac is used for leaching." Actually the UCCE Guidelines, recommends a ½ AF flood irrigation for land preparation, and 2 irrigations of ½ AF each for crop establishment (Mayberry, 1996, p 7). In addition, Dr. Bali in his study reports applying about ½ AF flood irrigation for land preparation prior to irrigation for crop establishment. **What irrigations exactly are accounted for in the WUE calculations;** and what was done about these irrigations in this study; i.e., how much water was applied and how was it accounted for?

2. Page 27: The effect of reduced surface runoff irrigations on **alfalfa yield** was only minimal (less than 2% reduction); see also Page 32, Table 9 and Table 10, and Page 51: Effect on alfalfa yield was only minimal (less than 2%) reduction. Please specify whether this is for dry yield or at 10% moisture. Also, give values for expected yield data and source.

Typically, farmers make 8 to 9 cuttings/year. In study, there were 8 cuttings the first year and 7 cuttings the next two years. If an extra irrigation were applied for each of these extra cuttings, the water application would be increased – the impact on the WUE in such a scenario is not known.

3. **Runoff reduction** implies that runoff was reduced from some percentage to some other percentage. So in the study runoff was reduced to 2% -- **this should be compared to what value** when considering the irrigation recommendations presented in the UCCE Guidelines?

Specific Questions:

1. Page 30: "Except for a few occasions when the IID canal water ran dry during an irrigation event, we had complete control of when to turn the water on or off to (sic) the field." Explained what happened. Why was an irrigation event scheduled during a period when the water supply would be out?

2. Page 37: Cutoff distance guideline – do application flow rate and/or field slope impact the cutoff guideline?

ALFALFA, pages 44 to 49

1. Page 46: Please specify how much of the field is represented by the lower end in, "... almost the entire alfalfa yield at the lower end of the field is commonly lost to scalding."

2. What are typical yields for alfalfa at UCDREC?

3. What happened in 1997 and 1998 to reduce yield to 6 ton/ac from the 10 ton/ac in 1996?

4. Did hay quality vary for these years? Only hay quality information provided is for 1997.

5. Please provide yield and WUE values for the two borders that received the extra irrigation in 1997 as compared with the borders that did not receive extra irrigation (8% increase in AW, 27% to 31% yield increase); also make clear the effect on the overall average

6. Please provide ET_c values for alfalfa for the years of the study, and compare water available to the crop with the ET_c

7. Explain the source of water from the water table, from what depth does it come, in what amounts, etc.

8. Page 48, to assist the reader, provide a brief description of the mass flow method (Wallender et al. 1979) used to estimate water table contribution – either in the paper or as an appendix

9. Page 49, what was the date of the leaching irrigation and how much water was applied

10. Please provide specific dates for data described in the top paragraph and in Table 25

11. Page 49, notes that "greater upward water movement occurred at the lower end of the field as compared to the upper end of the field." How is it known that the "leaching" was not movement of water to the presumable lower end of the field?
12. Explain what caused the water table contribution to be so greatly reduced after the first year
13. Re Fig. 49, p 71 and comments pages 47 and 48: Explain the mechanism which caused the water table to decrease so much in 1996, less in 1997 and hardly at all in 1998
14. Fig 50, invert scale to match Figs. 46 through 49
15. As an adjunct to Figs 46-49 and in the same layout, provide a Fig. showing the average root depth throughout the growing season
16. Fig. 49: Explain what caused the water table to increase more than 20 inches from Day 600 to Day 650, or so
17. Explain why there was hardly any decrease in the water table from after Day 650, or so, to the end of the experiment
18. Fig 43 & Fig 44. What was done to reduce the Soil Salinity profiles from those shown in Fig. 43 (alfalfa) to those shown in Fig 44 (corn)?
19. In Table 22, page 43, for each irrigation event, provide Julian days as well as Gregorian days .
20. Page 51: Alfalfa crop coefficient 0.84; Sudan grass crop coefficient of 0.81 -- what is typical in the Valley for each?
21. To assist the reader/user, provide a brief description of the Grismer and Tod method (1994) to estimate volume of cracks and cutoff distance or time.

CORN

1. Page 46: What kind of corn was grown? How was it irrigated – using the reduced runoff technique? What was the yield/ac? What was the quality?
2. Please describe the leaching irrigation and amount applied prior to planting sweet corn. How and where do we account for this irrigation in the Water Use Efficiency calculations?

Editorial Comments:

1. Throughout document, style where a numerical range is indicated as "2.8-3.0 million acre-feet" can be confusing, not clear at times if the hyphen is being used as a hyphen or a minus sign. Therefore, where it is meant to indicate 2.8 to 3.0 million acre-feet, use the preposition "to" or in some cases "through" instead of the hyphen/minus sign.
2. Use cut-off or cutoff, choose one style then check throughout for consistency
3. Flow rate is two words in English, Figs. 2-13
4. Paragraph 1: "... an (sic) recently agreed upon allotment of 3.1 MAF of Colorado River water..." The agreement is not finalized, revise this statement
5. Provide Fig. and Table to summarize data included in the Executive Summary
6. Page 2, last paragraph, Line 4: "The effect of reduced surface runoff irrigations..." What is a surface runoff irrigation?

Field 1	Sudangrass		April 1996	April 1997	April 1998	
Field 2	Alfalfa	Nov 95	1996	1997	July 1998	
Fields 1 & 2	Corn					Feb 1999

	Sudangrass (tons/AF/ac)	Alfalfa (tons/AF/ac)
Test AWUE	1.77	1.76
Test WUE	1.75	1.54
CA AWUE		1.80
AZ AWUE		1.49
Imperial Valley AWUE		1.17

7. Please provide the missing data, also tables like the above would assist the reader of the Executive Summary.
8. Page 3, "We found that shutting off..." line 3, reducing runoff to only 1-6% -- begs the question, reducing from what base?
9. Page 3, "Water table contribution (WTC) ...", what is the WTC to sudangrass?
10. Page 4, paragraph 1, line 2: change to read: "... improve **on-farm** irrigation efficiency"
11. Page 4, Use of CIMIS reference ET data for irrigation scheduling was not clearly presented in this report
12. Page 6, paragraph 1: ... salinity of the Sea is over 47,000 ... This statistic is not relevant to the study, unless you mean to show that reducing runoff would increase the salinity of the Sea. If that is your intention, please add the comment
13. Page 6, paragraph 3: "This research and demonstration project was conducted at UCDREC to verify the effectiveness of this method..." To verify what method? The Tod-Grismer procedure, or what? Not clear from this sentence.
14. Page 6. Objective: "The objective of this **Handbook** ..." Handbook was not mentioned in the paper title.

15. Page 6: "Irrigation **scheduling** can be based on a relatively simple technique that predicts the cut-off time ..." One would use CIMIS to schedule an irrigation, i.e., to determine when to irrigate. It would be better to state, "The cut-off time can be determined using a relatively simple technique."
16. Page 7, first 2 lines: "... the total volume of water applied equals the volume stored on the surface plus that below (subsurface storage)." -- **when there is no runoff**
17. Page 7, paragraph 2: "... volume of applied water can be estimated from **onflow** (sic) rate ..." Onflow is not a word in the English language. Replace with "flow rate" wherever it occurs in this report.
18. Page 7, paragraph 2: "Figure 1 schematically illustrates this concept" – the Tod-Grismer concept, or what?
19. Page 7, Fig 1. Provide a title, What is being illustrated in this figure is NOT CLEAR
20. Page 21: USDA **Soil** (sic) Conservation Service (NRCS). Replace "Soil" with Natural Resources
21. Page 22: Advance ration (ft/min) – is this the advance rate?
22. Page 24: Field Characteristics: Crop & maturity – does this mean Surface roughness? Since a range of values is provided for this parameter, it would be best to use this term
23. Flow rate (cfs) Q – "These measurements are taken when the surface wetting front has advanced $\frac{1}{4}$ to $\frac{1}{3}$ of the border length down the field – how is the user of this material to make this measurement?
24. Page 27: See comments for pages 2 and 3
25. Page 31: focus of this work – Reduce the frequency of application to utilize the shallow ground water (alfalfa fields). This was not evident in the Executive Summary presentation
26. Please provide list of abbreviations

20-152

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

**ESTIMATED COST
OF CONSERVATION:
IMPERIAL VALLEY
PHASE 2**

December 30, 1997

Board Members—

This info. was
distributed today
at Dave Kennedy's
MWD/SPCWA

negotiating session.

MWD said that
they were in "informal
negotiation" with IID
and that this info was
developed jointly w/
IID.

I'm preparing
a response.

Mike Clinton

10 pages

COST OF CONSERVATION

- **Projects identified in IID's 1996
*Water Requirements and Availability
Study***
 - **Tailwater Return Systems**
 - **Reservoirs**
 - **Lateral Interceptors**
 - **Seepage Recovery, Plus**
 - **On-Farm Water Management**

COST OF CONSERVATION

- Capital cost and O&M expenditures based on IID Phase 1
- 15 percent Project Management and Verification cost
- 10-15 percent Engineering cost
- 10 percent Contingency

TAILWATER RETURN SYSTEMS

- 115 Systems: Pond, pumping plant, pipeline
- Monitoring System to measure flow volumes
- Capital Replacement Fund
- IID Administration Cost
- Average Cost (\$/AF): \$243

\$15 / acre
incentive

RESERVOIRS

- Unit cost based on Phase 1 construction cost
- O&M cost based on Galleano and Bevins
- 10 percent Contingency
- 15 percent Engineering
- Average Cost (\$/AF): \$98

10 Reservoirs

LATERAL INTERCEPTORS

- 13 multi-purpose systems: concrete lined open channel
- Layouts and basic costs based on: *The Additional Lateral Interceptor Systems Implementation Priority Study* (CH2M Hill, September 1993)
- Costs revised to reflect changes in configuration and design criteria
- 10 percent Contingency
- 15 Percent Engineering
- Average Cost (\$/AF): \$176

EAST HIGHLINE CANAL SEEPAGE RECOVERY

- Includes four surface and five subsurface recovery systems
- Costs based on actual IID costs for similar seepage recovery projects
- Average Cost (\$/AF): \$20

ON-FARM WATER MANAGEMENT

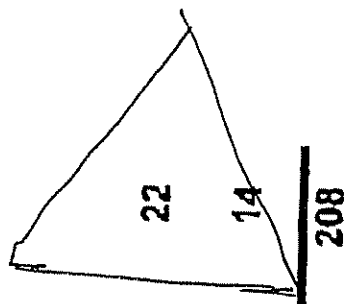
- Envisions greater dialogue between farmers/irrigators and IID staff
- Administers water delivery more accurately and in a timely manner
- Provides flexibility to shut off the water delivery when an irrigation event is completed

ON-FARM WATER MANAGEMENT (cont.)

- Capital and O&M costs for the installation of meters on the delivery gates and tailwater boxes
- Based on actual costs from Phase 1
- Includes replacement of defective tailwater boxes and 10 percent contingency
- Performance based incentive payment to farmer based on decreasing water use up to 100/AF
- Average Cost (\$/AF): \$233

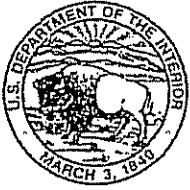
IMPERIAL VALLEY PHASE 2 COSTS

Project	Annual Yield (AF)	Total Yield (AF) ¹	Cost (\$M) ²	\$/AF
Tailwater Return Systems	19,320	305,510	74.32	243
Reservoirs	21,000	322,100	31.69	98
Lateral Interceptors	81,125	1,316,700	231.80	176
Seepage Recovery	19,850	383,650	7.84	20
On-Farm Water Management	58,500	906,750	210.96	233
Project Planning/ Management/ Verification/ Insurance			72.05	22
Indirects ³			44.16	14
Totals	199,795	3,234,710	672.82	208



- 1) Cumulative Yield 1998 through 2020
- 2) On-Farm Water Management costs include performance based incentive of up to \$100/AF.
- 3) Estimate for other costs including environmental mitigation

20-153



IN REPLY REFER TO:
LC-1000

United States Department of the Interior

BUREAU OF RECLAMATION
Lower Colorado Regional Office
P.O. Box 61470
Boulder City, NV 89006-1470

DEC 19 1996

Mr. Michael J. Clinton
General Manager
Imperial Irrigation District
P.O. Box 937
Imperial, CA 92251

Dear Mike:

Your letter of December 12, 1996, summarized our telephone discussion that same day regarding IID's water order for 1997. In essence I told you that we had concern about approving your 1997 water order for nearly 3.3 million acre-feet. As you know we have had concern for some time about IID's water use and the extent to which that use does or does not represent "beneficial use" under your contract. Our water use assessment report, prepared by Dr. Marvin Jensen and released in August of 1995, provided a detailed analysis documenting our concerns. Based on analysis contained in that report, we considered making adjustments in your water order for 1996 pursuant to 43 CFR 417, but refrained from taking formal issue with it in the hope that ongoing discussions among the California entities would result in some resolution of this issue. I am sure you will recall a phone discussion we had nearly one year ago on this subject in which you asked that we delay sending any formal letters while negotiations were under way among the California contractors.

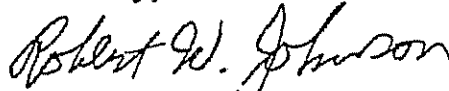
Incidentally you recently referred to the Jensen report as the "discredited Jensen Study." We believe it is important to inform you that yours is an opinion we do not share. Dr. Jensen has recently indicated that "if the report were done today, the results would be supported much more strongly with data that is now available." We continue to support the validity of the report.

Your December 12, 1996, letter also makes reference to pressure on us from others to reduce agricultural use of water in California. While it is true that others are taking a high level of interest in California water use, I think it is important to make it clear that we are not expressing our concerns because of pressure from others. Rather, we are expressing concerns because of our honest view that all of IID's water order is not required for beneficial use. Our water use assessment report prepared over one year ago documents that concern, as do our long standing efforts to work

collaboratively with IID to obtain objective collection and analysis of reasonable water use data within IID. To that end, your letter correctly states that we are still interested in implementing the partnership agreement.

As we discussed in the phone call, we are willing to discuss our concerns with you before formally taking any written action. We look forward to that dialogue.

Sincerely,

A handwritten signature in cursive script that reads "Robert W. Johnson". The signature is written in dark ink and is positioned above the printed name and title.

Robert W. Johnson
Regional Director

20-154



United States Department of the Interior

BUREAU OF RECLAMATION

Lower Colorado Regional Office

P.O. Box 61470

Boulder City, NV 89006-1470

IN REPLY REFER TO:

BCOO-4640

WTR-4.03

MAR. 03 1999

W.D. - response
[Signature]

Mr. Jesse Silva
Acting General Manager
Imperial Irrigation District
P.O. Box 937
Imperial, California 92251

Subject: Water Conservation Studies by University of California - Davis (U.C.-Davis)

Dear Mr. Silva:

This letter is in response to a December 11, 1998, letter from then General Manager, Michael Clinton, about our meeting regarding the management of Colorado River water supplies available to California agricultural agencies. I introduced the phrase "low hanging fruit" to clarify the concept of inexpensive Imperial Irrigation District (IID) water conservation. This phrase was intended to identify water conservation measures which can achieve major water-use reductions utilizing small additional labor inputs with no resultant yield decreases or increases in soil salinity. I believe, and stated in our meeting, that studies by U.C.-Davis indicate the availability of such conservation measures to reduce water use at IID.

We have reviewed your comments in the December 11, 1998, letter and have consulted with Dr. Mark Grismer, Professor, U.C.-Davis and Dr. Khaled M. Bali, Farm Advisor Irrigation/Water Management, U.C. Cooperative Extension, Imperial County, regarding this matter.

Dr. Grismer and Dr. Bali indicated that the 1997 professional paper you described was published in England. It summarized the work accomplished by Dr. Frank Robinson, U.C. Water Scientist, while he was under contract with the Metropolitan Water District. The quote made in the December 11, 1998, letter was related to Dr. Grismer's final summary of Dr. Robinson's work regarding dropping summer irrigations of alfalfa when water-use efficiency (in terms of yield per acre-foot of water applied) is quite low. That is why you may see yield losses of alfalfa and subsequent salt-leaching required to restore satisfactory soil conditions.

Publication of results of the runoff reduction work of the past 3 years has been limited to annual progress reports and meetings attended by representatives of IID, Reclamation, and the California Department of Water Resources. These progress reports indicated that Dr. Grismer and Dr. Bali have found very little yield reduction in alfalfa and no yield loss in sudan grass over an irrigation season using the cutoff irrigation method to minimize tailwater runoff. The data also indicate that maintaining a 5 percent runoff volume eliminates any increase in soil salinity for both alfalfa and sudan grass, and that there may be an average savings of 10-12 percent of applied water for these

crops district-wide, if the runoff-reduction methods were adopted. These progress reports are enclosed for your review.

Your presentation in our meeting implied that water conservation could only occur through the relatively expensive tailwater return systems. My comment was intended to point out that farmers in IID may opt to implement less expensive conservation measures to achieve at least part of the planned conservation program.

The December 11, 1998, letter also indicated that we have been affected by anti-IID propaganda put out by junior entitlement holders. This simply is not true. Reclamation is obligated by Part 417 of Title 43, Code of Federal Regulations to see that deliveries of Colorado River water not exceed those reasonably required for beneficial use. In this regard, our goal is to be fair and objective in our administration of the Colorado River entitlements. While we listen to all sides of any particular issue, any conclusions we draw are based on our honest interpretation of the facts involved.

I look forward to our continuing effort to resolve this and other Colorado River issues.

Sincerely,

ACTING FOR

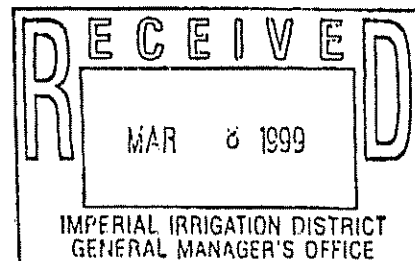


Robert W. Johnson
Regional Director

Enclosures - progress reports

cc: Mr. Khaled Bali
Farm Advisor
Cooperative Extension
1050 East Holton Road
Holtville CA 92250-9615
(w/o encs.)

Dr. Mark Grismer
Professor of Agricultural Engineering
University Of California
Department of LAWR
209 Veihmeyer Hall
Davis CA 95616-8628
(w/o encs.)



20-155



Winston H. Hickox
Secretary for
Environmental
Protection

State Water Resources Control Board

Office of Chief Counsel

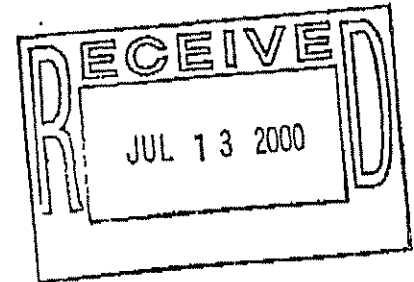
901 P Street • Sacramento, California 95814 • (916) 657-2154
Mailing Address: P.O. Box 100 • Sacramento, California 95812-0100
FAX (916) 653-0428 • Internet Address: <http://www.swrcb.ca.gov>



Gray Davis
Governor

July 11, 2000

CERTIFIED MAIL



Mr. William E. Hvidsten
De Cuir & Somach
400 Capitol Mall, Suite 1900
Sacramento, CA 95814-4407

Dear Mr. Hvidsten:

REQUEST FOR REDESIGNATION OF BENEFICIAL USES FOR IMPERIAL VALLEY WATERS

Mr. Phil Gruenberg has requested I respond on his behalf to your letter dated May 20, 2000. Your letter, submitted on behalf of the Imperial Irrigation District (IID), requests that the Colorado River Basin Regional Water Quality Control Board (Regional Board) "redesignate" and "re-define" beneficial uses for the New and Alamo Rivers without performing a use attainability analysis. In its request, the IID objects to the definition of recreational (REC-1 and REC-2), freshwater replenishment (FRSH), and warm freshwater habitat (WARM) beneficial uses for the New River, Alamo River, and Imperial Valley drains contained in the *California Regional Water Quality Control Plan for the Colorado River Basin Region* (Basin Plan).

The Basin Plan designates the beneficial uses for all the waters of the region (surface and ground waters) and establishes the water quality objectives to protect those uses. The Regional Board adopted its Basin Plan pursuant to the water quality planning provisions of the California Water Code section 13240, et seq. The Basin Plans and Basin Plan revisions thereof are then subject to the approval of the State Water Resources Control Board (State Board) Water Code section 13245. The Imperial Valley drains and the Alamo and New Rivers are surface waters of the United States, in part, because their waters are used for interstate and foreign commerce and because they are tributary to navigable waters (40 C.F.R. § 110, et seq.). The Federal Water Pollution Control Act (a.k.a. the Clean Water Act; U.S.C. § 1251, et seq.) and Title 40 of the Code of Federal Regulations contain the legal and regulatory criteria regarding water quality standards for surface waters of the United States (40 C.F.R., Part 131, et seq.). Because the Basin Plan establishes water quality standards for surface waters pursuant to federal law, changes in those standards are also ultimately subject to the review and approval of the United States Environmental Protection Agency (USEPA).

Mr. William E. Hvidsten

- 2 -

July 11, 2000

The Regional Board recognizes recreational, freshwater replenishment, and warm freshwater habitat as actual uses which are likely to continue in the New River, Alamo River and Imperial Valley drains. These designated uses for the New River, Alamo River, and Imperial Valley drains are contained in the Basin Plan as existing uses. Existing uses, defined by Title 40 of the United States Code of Federal Regulations (40 C.F.R.), Subchapter D, Part 131.3(e), are those uses actually attained in a water body on or after November 28, 1975, whether or not they are included in the water quality standards. 40 CFR requires that existing uses be designated. Unless a more stringent use is established in lieu of the designated use, 40 CFR prohibits the removal of or dedesignation of an existing use.

In addition, Title 40 authorizes dedesignation and partial dedesignation of a use only if the use is a potential use and the state demonstrates that attaining the use is not feasible for one of the reasons contained in 40 CFR § 131.10(g). If a potential use, however, will be attained by the implementation of technology based effluent limits for point sources of pollution and implementation of BMPs to control non point sources of pollution, the use may not be removed (40 C.F.R., Part 131.10(d)). Even if the beneficial uses you discuss were potential uses and not existing uses, consideration of dedesignation is premature and would require a use attainability analysis.

At this time, the implementation of cost-effective and reasonable best management practices (BMPs) for nonpoint source control have not been implemented for the New River, Alamo River or Imperial Valley agricultural drains to achieve and protect the beneficial uses of these waters. As IID is aware, the Regional Board is currently preparing a Total Daily Maximum Daily Load (TMDL) and implementation program for the Alamo River. The program will propose many BMPs for silt in the Alamo River and the agricultural drains that are tributary to the Alamo. TMDL and implementation programs will be prepared in the future for other impaired water bodies in the region including the New River. After the implementation of limits and controls, if a potential use cannot be attained, the federal regulations provide for beneficial use modification. However, the state must demonstrate infeasibility and a Use Attainability Analysis is required prior to modification of any instream uses (e.g. recreational uses and habitat) (40 C.F.R., Part 131.10(j)).

IID argues in its request that no use attainability analysis is required. IID argues that it simply requests that the Board "redefine" or "redesignate" the definition of the beneficial uses. Although IID chooses not to use the terms "removing a beneficial use", the practical result of IID's request would be to limit or remove part of the existing beneficial uses. Removal or dedesignation of an existing use is clearly prohibited.

The Regional Board hopes that IID will continue to work with the Regional Board to address the severe impairments for the New River, Alamo River and Imperial Valley drains via the Total Maximum Load Process—a process that provides for the development of appropriate targets and pollutant load allocations for those waters.

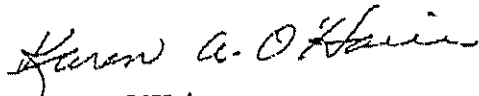
Mr. William E. Hvidsten

- 3 -

July 11, 2000

If you have any questions about this matter, please call me at (916) 657-2088.

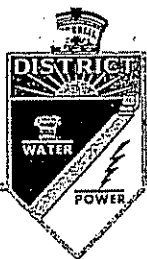
Sincerely,



Karen A. O'Haire
Senior Staff Counsel

cc: Colorado River Basin RWQCB Members
Mr. Phil Gruenberg, CRBRWQCB
Mr. Jose Angel, CRBRWQCB
Mr. Stan Martinson, DWQ, SWRCB, Sacramento
Ms. Felicia Marcus, USEPA, Region IX, San Francisco
Ms. Alexis Strauss, USEPA, Region IX, San Francisco
Mr. Terry Oda, USEPA, Region IX, San Francisco
Ms. Eugenia McNaughton, USEPA, Region IX, San Francisco
Mr. Jesse Silva, IID, Imperial
Mr. Brad Luckey, IID, Imperial

20-156



IMPERIAL IRRIGATION DISTRICT

OPERATING HEADQUARTERS • P. O. BOX 937 • IMPERIAL, CALIFORNIA 92251

(760) 339-9751
FAX (760) 339-9009

RPM

October 29, 2001

FAXED & MAILED

Jonathan Rokke
California Regional Water Quality Control Board
Colorado River Basin Region
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260
(760) 341-6820 FAX

Subject: Comments – 2001 Triennial Review, Colorado River Basin Plan

Dear Mr. Rokke:

The Imperial Irrigation District (IID) has reviewed the Water Quality Control Plan for the Colorado River Basin (Basin Plan) and appreciates being offered the opportunity to provide comments for the 2001 Triennial Review. Of ongoing concern to IID is the refinement of the beneficial use definitions. The designation of beneficial uses constitutes the foundation of California's water quality program. Once the use is identified, water quality objectives are established to ensure that the uses are reasonably protected. If beneficial uses for a water body are improperly designated, overly stringent water quality objectives could be applied.

The beneficial use categories provided in the Basin Plan, as currently written, are overly broad and do not accurately or adequately reflect the characteristics of the Alamo and New Rivers or the Imperial Valley agricultural drains as they existed when designated. The Alamo and New Rivers are not natural free flowing rivers, but are actually desert washes that would be dry most of the time if not for the agricultural drainage water. Unlike natural streams, agricultural drains in the Imperial Valley are manmade waterways constructed to convey agricultural drainage water. IID believes it is inappropriate to designate desert washes or constructed waterways dominated by agricultural drainage as fishable/swimmable REC I water bodies that are comparable to natural freshwater streams. Despite the regulatory prohibition against designating the conveyance of a waste as a beneficial use, the source and type of water to be conveyed by the waterways should still be considered in designating the beneficial uses of the Alamo and New Rivers and agricultural drains. Moreover, the source and type of water should be taken into consideration when defining the associated water quality objectives to protect those uses. Where the flow due to agricultural drainage has provided the water necessary to

sustain life in the rivers and the drains, which would not have otherwise occurred, the level of protection should bear a rational relationship to the quality of the water which initially created the aquatic habitat and the types of aquatic life that are capable of existing in waters of this type.

The aquatic and wildlife beneficial uses that have developed after the construction of the drains, while clearly incidental to the original intended purpose of the drains when constructed, are specifically protected by statute and regulation. IID requests the Regional Board develop a more suitable and consistent list of beneficial uses, water quality objectives, and an implementation process that is appropriate for these systems and which does not undermine the intended purpose of the drains.

The current beneficial uses recognized by the Regional Board and the Basin Plan for the Imperial Valley agricultural drains and the Alamo River are FRSH (Use of water for natural or artificial maintenance of surface water quality or quantity), REC I (Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonable possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, and use of natural hot springs), REC II (Uses of water for recreational activities involving proximity to water but normally not involving contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities), WARM (provides a warm water habitat to sustain aquatic resources associated with a warm water environment, WILD (Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates), and RARE (Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered).

IID notes that the WARM beneficial use actually means Warm Freshwater Habitat. Under the U.S. Fish and Wildlife Service's handbook for habitat classification, the term "freshwater" means having a TDS of less than 500 PPM. Water brought into the Imperial Valley by the All American Canal contains 700 ppm TDS and the Alamo and New Rivers contain approximately 2,400 to 2,600 ppm TDS. As a result, the designation of Warm Freshwater Habitat is subject to question.

IID proposes that the Regional Board modify the definition of REC I, REC II, and WARM to more accurately reflect the conditions of the Alamo and New Rivers and the Imperial Valley agricultural drains when the initial designations were made. The refinement of the definitions of the existing uses will more accurately describe the water bodies at issue. It is not intended and should not be construed as an effort to diminish water quality, but rather acknowledge real world conditions.

The Alamo and New Rivers and the agricultural drains are unique in that they do not have the hydrologic and ecological characteristics and water quality necessary for full

attainment of the beneficial uses normally associated with natural streams. The modified definitions do not undermine the incidental uses, i.e. fishing, as there is adequate flexibility to designate uses of agricultural waters which reflect the unique physical, biological, management characteristics, and resulting limited aquatic life uses of these waters dominated by agricultural drainage. Through the flexible process, appropriate objectives and implementation procedures can be developed which facilitate appropriate management activities while protecting designated uses.

By acknowledging the unique characteristics of the water bodies supplied primarily by agricultural drainage, the Regional Board will begin to address the concerns of the regulated community and solidify a cooperative mode as we move toward the implementation of Total Maximum Daily Loads (TMDL). It will also dispense with the regulated community's perceived need to challenge the listing of the Alamo River and the agricultural drains as waters of the United States. By appropriately considering and adopting changes to the beneficial use designations, the Board can maintain the water quality necessary to protect and preserve existing beneficial uses and at the same time acknowledge the real world limitations on the waters of this region.

IID also requests that the Regional Board re-examine the water quality objectives applicable to these waters and establish separate water quality objectives appropriate for these waters. In establishing and applying these narrative water quality objectives to agricultural waters, IID requests that the Regional Board develop new water quality objectives based on local species and ambient conditions or, in the alternative, use the lowest mean acute value of toxicity tests.

Once again, IID thanks you for the opportunity to comment on the Water Quality Control Plan for the Colorado River Basin during this 2001 Triennial Review period. If you have any questions regarding these comments or would like IID to participate in the development of revised beneficial use definitions or water quality objectives, please contact me at (760) 339-9751.

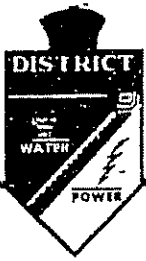
Sincerely,



ELSTON K. GRUBAUGH
Manager, RP&M

TAS:lh

20-157



(760) 339-9477
Fax (760) 339-9392

IMPERIAL IRRIGATION DISTRICT

OPERATING HEADQUARTERS • P O BOX 937 • IMPERIAL CALIFORNIA 92251

September 25, 1997

cc: WR
Eldon/Fin

Gary L. Bryant, Area Manager
U. S. Bureau of Reclamation
P. O. Box D
Yuma, AZ 85366

Dear Mr. Bryant: *Gary*

Subject: Updated Water Conservation Plans (WCPs)
Your Letter of July 22, 1997

Thank you for arranging the water conservation workshop on August 21, 1997 in Yuma, carried out pursuant to the Bureau of Reclamation (Reclamation) final policy for developing and administering WCPs. The conference's significant references to the relationship of the WCPs to the California AB 3616 process supports the concept of a partnership between IID, Reclamation, and the California Department of Water Resources which was outlined in my July 22, 1997 letter to the Regional Director. The purpose of this letter is to summarize our understanding of the workshop presentation and show how IID is moving forward in meeting our respective objectives.

An important topic of discussion was concurrent compliance with California water conservation programs and the WCPs by using California's AB 3616 water management plans to satisfy the WCP requirements of Reclamation. We understand that your office intends to defer to the AB 3616 process and intends to allow districts to take up to two years, if necessary, to develop water management plans (the AB 3616 schedule). IID also understands that Reclamation intends to eventually determine if the AB 3616 water management plans developed by the California Colorado River districts can serve as WCPs under existing policy and the requirements of Section 210 of the Reclamation Reform Act of 1982 (RRA).

This is an appropriate manner in which to develop an effective water conservation program. Indeed, the Reclamation policy guidelines you conveyed to IID in February 1997 provide on page 2 that districts may be exempted from the requirement to prepare water conservation plans under the RRA where such districts "have prepared water conservation plans, or are meeting alternative standards, for other Federal or State agencies, that fulfill

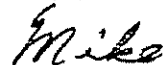
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the intent of Section 210(b) of the RRA." This policy guideline is completely consistent with Reclamation's five-year Strategic Plan, which provides in Strategy 5 (page 14) that "Reclamation will avoid duplicating [water conservation plan] efforts already implemented by State agencies and Tribes, and will work in concert with those entities to supplement and complement their efforts."

Of equal importance is IID's commitment to the development of a successful water conservation/transfer agreement with the San Diego County Water Authority. Once put into operation, the funding to be made available through this agreement will enable IID and the skilled farmers in our district to reach new levels of effective water conservation and overall water management. In this regard, we are encouraged by the recent letter from Commissioner Martinez to Craig Bell of the Western States Water Council, wherein Mr. Martinez said: "In the Record of Decision [concerning RRA regulations], Reclamation also made an environmental commitment to pursue administrative means to work closely with States and others to develop mechanisms for Reclamation to more actively encourage and facilitate transfers of Reclamation-supplied conserved water, for environmental and other purposes" (emphasis added).

For your further information, IID staff is already moving forward to prepare the IID Water Management Plan to meet the AB 3616 requirements. Also, we are prepared to fine tune those actions as may be appropriate under any partnership agreement which IID may enter with Reclamation and the California Department of Water Resources. You and your staff are invited to work with us, our farmers, and community in this effort.

Sincerely yours,



MICHAEL J. CLINTON
General Manager

cc Bob Johnson, Regional Director

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Steve Knell's
Drainage Speech

HISTORICAL INFORMATION

MAIN AND LATERAL DRAINS

Irrigation began in 1901 in the Imperial Valley and as early as 1902, soil scientists called attention to the need for drainage. Drainage investigations were recommended by U. S. Department of Agriculture, but no funds were available from the Congress or from the Department of Agriculture for such a study. As a result, by 1919 approximately 100,000 acres of irrigated lands were effected in some degree by a high water table and/or salt accumulation.

In 1922, after a drainage survey had been made and plans recommended by a Consulting Drainage Engineer, Mr. Daniel W. Murphy, the Imperial Irrigation District began the construction of an open "main" drain system. A \$2,500,000 Bond Issue was authorized for the construction of a main drain system which would serve as outlets for the network of lateral drains to be constructed at approximately one-half mile intervals. All this drain system would flow into the existing natural desert washes, the New and Alamo Rivers, and eventually to the Salton Sea.

The lateral drain system was built in cooperation with the adjacent landowners. The financing was based on the landowners contributing \$800 per mile to the initial cost of construction of the open lateral drains and also furnishing the right of way (usually 80 foot width) needed for excavation of the drain and accommodation of the spoil. The District constructed the drains with its forces and assumed all costs in excess of \$800 per mile.

Today this intricate drainage network consists of nearly 1,451 miles of open main and lateral drains. The drainage system is set up to provide a surface and subsurface drain outlet for each quarter section of land. Drains vary in depth from 11 feet in the main drains to an average of 7 feet in the lateral drains.

The IID expends nearly \$1,850 per mile on maintenance of its main and lateral drain network. This work includes the removal of silt deposits, weed control and removal, repair and replacement of drainage structures and grading of the drainage canal banks. Exhibit 1.3 delineates the main and lateral drain network constructed within the Imperial Valley.

Since the drainage system was constructed in the relative recent history of the IID, a very detailed record of each drain's construction and maintenance has been maintained.

ALAMO RIVER

Today the Alamo River plays an intricate part of the drainage network of the IID. This 55 mile channel receives drainage discharges from 78 main and lateral drains within the irrigated acres of the Imperial Valley. The Alamo River has a hydrologic regime similar to that of the New River. The difference lies in the very small agriculturally generated inflow from Mexico at the International Border. Historically the mean flow has been only 2.2 cubic feet per second and ranged from 1 to 4 cubic feet per second. This inflow was principally from agricultural activity south of the border and seepage waters from the All American Canal. A few years ago the IID installed a seepage water recovery system in this area to reduce All American Canal losses.

Although the Alamo River has a much lower flow than the New River at the border, it has a significantly higher flow at the outlet to the Salton Sea. Mean discharge to the Salton Sea is 860 cubic feet per second. This flow volume is generated by agricultural flows within the Imperial Valley, with minor input from sewage treatment return flows.

The Alamo River was not always a drainage channel. Exhibit 1.4 shows an overview of the Imperial Valley's water distribution system in 1911. As can be seen from this exhibit, the Alamo River played an important role in the distribution of irrigation water as well. From Sharp's Heading, south of the border, water was diverted into the Alamo River to supply irrigation diversion works located west of the city of Holtville (e.g. Rositas Dam) to supply the Redwood and Rose Canal system and at the North End Dam to supply water to what is today called the Vail Canal System.

Both as an irrigation and a drainage canal the Alamo River has continued to be manipulated and controlled by man. Prior to and for a brief interval after the flood of 1905 the Alamo River was principally maintained as an irrigation canal. It has been channelized, dredged, reshaped to provide additional farmland and manipulated to improve its hydraulic carrying capacity. The flood of 1905 widened and deepened the Alamo River by as much 20 to 30 feet in some places. This deeply eroded channel played a natural role as a discharge point for the extensive drainage system which was to be constructed later.

Today the Alamo River is completely dominated by man-controlled activities. The IID regularly dredges and clears this waterway to maintain its drainage outlet facilities at an annual cost of \$710 per mile. The lower end of the Alamo River at the Salton Sea is extensively channelized and dredged to maintain an adequate outlet. Over the years, the IID has installed 10 reinforced concrete drop structures to control this drains grade and to reduce erosion.

NEW RIVER

South of the Mexican Border the New River serves as a drainage outlet for the northern portion of the Mexicali Valley, draining some 280,000 acres in one of the largest and most important irrigated agricultural areas in Mexico. Irrigation water for this area is supplied from the Colorado River under the 1944 Water Treaty and from ground water pumping. Most of the New River flow is irrigation return water. In Mexicali where the sewage collection and treatment system is not adequate to serve the population, discharges of untreated and partially treated domestic and industrial wastewaters enter New River.

North of the border, the New River is approximately 65 miles in length and receives irrigation drainage discharges from 56 main and lateral drains of the IID. The mean inflows from Mexico at the border are a sizable 221 cubic feet per second, although the minimum flow recorded is as low as 5 cubic feet per second. As the New River flows through Imperial Valley it receives additional runoff, primarily from irrigated farmland. Upon reaching the Salton Sea the outlet flow averages 723 cubic feet per second. Historical accounts indicate that the New River was a rather small channel at the turn of the century. However, man was soon to change the face of this desert wash.

In 1901 the Imperial Valley received its first taste of water through the Alamo Canal constructed in Mexico. A diversion works was constructed in the Colorado River to divert water into the channel but no method was installed to divert the water out of the Alamo Canal. A series of flood events on the Colorado River in 1904-05 widened the intake to the Alamo Canal to the point that the whole flow of the Colorado River was entering the Alamo Canal and hence the Imperial Valley.

During the break, the large flow of water through the Alamo Canal caused an overflow for many miles and created a very serious situation. The larger part of the water overflowed the south bank of the Alamo Canal and collected in the New River channel in Mexico and thence passed down the west side of Imperial Valley to Salton Sea. At the closure of the break in 1907 the New River had been enlarged from a rather small channel to a gorge 40 to 60 feet in depth through Imperial Valley and extending for some six or eight miles into Mexico.

It is estimated that some 13,000 acres of irrigable land, part of which was in crop, was destroyed by the erosion of the Alamo and New Rivers. Replacement of this land would narrow the existing gorge width some 900-1000 feet.

The New River plays an important role in the extensive drainage system of the Imperial Valley. Like the Alamo River, the New River is extensively controlled by mans activities. The IID spends nearly \$1,225 per mile annually to insure and control the flow of this major drainage artery.

20-159



IMPERIAL IRRIGATION DISTRICT

OPERATING HEADQUARTERS • P. O. BOX 937 • IMPERIAL, CALIFORNIA 92251

February 28, 2000

WD-WRU ✓
WD-RMS ✓
WD ✓

Dr. Khaled M. Bali,
Farm Advisor, Irrigation/Water Management
University of California Cooperative Extension
1050 E. Holton Road
Holtville, CA 92250-9615

Re: Draft final report, Contract No. B-80560: Irrigation and Drainage Management
and Surface runoff Reduction in the Imperial Valley Project

Dear Dr. Bali,

Thank you for providing us with the opportunity to review and comment on your report.
Comments by IID staff are attached.

Sincerely,

John Eckhardt, Ph.D., P.E.
Manager, Water Department

cc: Dr. Baryohay Davidoff, DWR
Mr. Wayne Verrill, DWR
Mr. Steve Jones, USBR
Ms. Lauren Grizzle, Imperial Valley Farm Bureau

TECHINICAL REVIEW

Irrigation and Drainage Management and Surface Runoff Reduction in the Imperial Valley, DRAFT FINAL REPORT, Bali, et. al., December 1999

Executive Summary

1. The reference in the Executive Summary that, "This report describes the development of a new method to minimize runoff . . ." is hardly accurate. The practice of under-irrigating crops to extend water resources in areas where water is in short supply has been in existence for centuries around the world.

SECTION I *Best Management Practices*

2. Dr. Bali should accurately and completely describe the irrigation system used in his runoff reduction research. Pumping a constant rate from a field reservoir during daylight hours is not typical of surface water irrigation from an open channel canal system in the Imperial Valley. Dr. Bali's research plots experienced none of the head and flow variation inherent in an open channel canal system operated at maximum flexibility. Dr. Bali was able to start his pump when he was ready to irrigate, not necessarily at the Meloland Station's regular turn time. Dr. Bali was able to turn off his pump and end his irrigation events at the precise time he was finished applying water. He did not first have to notify IID for an early shut off and then wait for a zanjero (who is responsible for four canals and over 90 gates) to find the time to accommodate his request. Rather than focusing on a cutback irrigation scheme that, at best, might have limited applicability, perhaps the strongest conclusion that should have been drawn from Dr. Bali's research is the potential benefit of small on-farm and/or mid-lateral reservoirs.

3. Both those who believe that Dr. Bali's work should form the basis of a new irrigation paradigm in the Imperial Valley and those who believe that his work on this project has been flawed should note that a single research project at a state-run experimental station seldom translates into widely adaptable technology. The adoption of technological innovations in agriculture tend to follow a standard model. The wide spread applicability of promising field station research is evaluated across multiple conditions through on-farm demonstration projects. If shown to be applicable across a range of conditions a given technology is adopted over time as it gains acceptance and wider use. Promotion may decrease the time required from introduction to widespread acceptance. Dr. Bali and those who believe that his research should gain immediate acceptance and adoption should refer to *Communication of Innovations* (Rogers and Shoemaker, Collier-MacMillan, 1971) for a better understanding of the process of technology transfer. As I am sure Dr. Bali realizes, promotion of a research innovation before it has demonstrated widespread applicability can kill what may otherwise be a promising ideal. I am sure Dr. Bali also realizes that research with limited applicability will not be adopted regardless of the effort put into its promotion.

4. Having stated the importance of an on-farm demonstration program to the successful dissemination and adoption of agricultural research, Dr. Bali and those who believe that his research should be immediately adopted need to realize that conducting or funding such a program is not the responsibility of the Imperial Irrigation District. Dr. Bali and the UC Cooperative

Extension Service need to identify both cooperating water users and funding. Dr. Bali may wish to consult with his Extension counterparts in Texas concerning their extensive and well-respected on-farm demonstration program which is funded entirely by growers, commodity groups, seed companies, fertilizer and pesticide manufacturers, food processors, irrigation equipment suppliers, and private foundations.

Section II Summary of Field Trials

In general, Section II is greatly lacking in substantive material to support many of the claims promoted in the conclusion. IID has commented previously on many of the reports prepared by Dr. Bali for this project. Likewise, IID and the farm community have continually objected to many of the overly zealous conclusions presented by Dr. Bali. Most pressing are the following:

1. No Scientific Control: The report compares all data gathered in the study to “average values” of sudangrass and alfalfa in the Imperial Valley rather than to a scientific control plot. The lack of a control for comparison purposes is a serious flaw in the study.
2. Soil Type: Section 4.1 Soil Type and Page 33, Paragraph 2: All reference to soil 115 Glenbar silty clay loam should be changed to Imperial-Glenbar silty clay loam. The soil series should be accurately named, although the IID and the NRCS have continually maintained that the soil depicted as an Imperial-Glenbar in the study area is actually closer to a Holtville soil series.

The Imperial-Glenbar soil does not contain a sand lens at the 60-inch depth, as was observed in test pits at the station in the test site area. For Dr. Bali to continually state that the soil in the study area is typical of heavy clay soils in the Valley is misleading and incorrect. The reference used to substantiate this is Zimmerman (1981), see page 32. If one looks in *Section 7 References* in the report, you see this reference is nothing more than an overlay of the SCS Soil Survey for the field station, and the NRCS has maintained that the soil may have been wrongly mapped. Even the soil survey has an accuracy of +/- 10 acres.

Regardless, the soil survey states that Imperial-Glenbar is not well suited to growing alfalfa due to the heaving of the taproot from the soil's shrink-swell action. The fact that the study site seems to grow alfalfa well is another indication that this soil is misdiagnosed in the report.

3. Root Depth: No data is given for sudangrass root development. This needs to be included.
4. Crop Coefficients and Water Table Contribution: Statement on page 46, “The average crop coefficient ((Applied Water, AW + rain + water table contribution, WTC)/ET_o) for the entire growing season was 0.84.” The reader cannot tell from this formulation whether the crop coefficient or the water table contribution was the independent variable. Indicate how the crop coefficients and how water table contribution were determined.
5. Irrigation Scheduling: Explain how the Water Table Contribution was taken into account in determining when to irrigate and how much to apply, see also Points 6 and 10 below.

6. Water Table Contribution: Add a column indicating Water Table Contribution (WTC) for each irrigation period to Tables 9-11 for Sudangrass irrigation and Table 22 Irrigation information – Alfalfa field. Due to the soil characteristics of the UCDREC study areas, the water table contribution (WTC) is not representative of almost any other Imperial Valley field. Both 18% and 11% are very high.

7. Tailwater Runoff: The average runoff of 2% is not that unusual for sandy fields. This is a clay soil, but lies over a sandy lens below. David Bradshaw of IID's Irrigation Management Unit has pictures provided to him by Dr. Bali that illustrate this. The potential for the water to run to the groundwater may be a major contributor to the low tailwater, and may greatly impact the point in the field at which the irrigation has to be terminated to achieve the results indicated by Dr. Bali.

8. Soil Moisture Depletion: Both study test sites (area 70 and area 80) have soils with similar water holding capacities, see Table 11, page 32. According to Table 11, the available water is 0.2 in/in for depths of 0" to 48" in both areas. As can be seen from Fig. 50, the average root zone for the alfalfa is 30 inches. Thus, by simple math, the available water to the crop is 0.2 in/in times 30 inches = 6 inches total.

The study gives the Kc values for sudangrass as 0.81 and for alfalfa as 0.84. We know that $ET_o \times K_c = ET_c$. If you multiply the ET_o listed in the Table 14 *Irrigation information (sudangrass field) - 1996*, column 3, *ET_o since previous irrigation*, by the Kc for sudangrass, you derive the ET_c since the last irrigation. ET_c is the amount of water the crop would transpire since the last irrigation. Finally, the footnote for Table 11, page 32 states, *Allowable depletion: 50% for most crops, 50-65% for crops that are relatively insensitive to water stress*. Based on these facts and assuming that the sudangrass in the study area had a root depth of 30 inches, we find that the soil stores only 6 inches of water.

Thus, disregarding water table contribution (WTC), plant stress would occur once the crop had extracted 65% of 6 inches or at 3.9 inches, or 65% moisture depletion. From Dr. Bali's data, we can determine that even if the soil were to be at field capacity (6" of available moisture in 30" root zone), the moisture depletion levels exceed the stress soil moisture depletion level at which wilting occurs. This can be seen from the following:

After Table 14, p. 35, **Sudangrass irrigation – 1996 season**. $K_c = 0.81$, $ET_c = K_c \times ET_o$, 30" soil profile with 6" Available Water, i.e., Moisture Depletion = $ET_c/6$ "

Since Last Irrigation		
ET _o (in)	ET _c (in)	Moisture Depletion (%)
Pre-irrigation		
5.04	4.08	68%
7.57	6.13	102%
11.51	9.32	155%
7.87	6.37	106%
8.43	6.83	114%
7.40	5.99	100%

Thus, if the root zone were at field capacity after each irrigation, soil moisture availability prior to the next irrigation on the study sudangrass field would represent moisture depletion levels of 68%, 102%, 155%, 106%, 114%, and 100%. These are all above the allowable 65%.

Alfalfa stress also occurs at 65% depletion, 3.9 inches for a 30" root zone in soil types found in the study area. When values for ETo (in) since previous irrigation are multiplied by the Kc of 0.84, most resultant values are in the wilting point range for alfalfa. Especially look at the dates 9/10/96 and 11/1/96 where ETo is 11.11 inches and 10.75 inches, respectively. That is a moisture depletion of $[(0.81 \times 11.11)/6] \times 100 = 150\%$.

After Table 22, page 43, **Alfalfa irrigation**, $K_c = 0.84$, $ET_c = K_c \times ETo$,
30" soil profile with 6" Available Water, Moisture Depletion = $ET_c/6$ "

Date	Since Last Irrigation		
	ETo (in)	ETc, (in)	Moisture Depletion (%)
12/4/95	2.5	2.10	35%
1/22/96	3.64	3.06	51%
3/19/96	7.65	6.43	107%
4/24/96	9.46	7.95	132%
5/17/96	7.59	6.38	106%
6/7/96	7.16	6.01	100%
7/3/96	8.61	7.23	121%
8/2/96	9.23	7.75	129%
9/10/96	11.11	9.33	156%
11/1/96	10.75	9.03	151%
12/20/96	4.38	3.68	61%
2/19/97	5.9	4.96	83%
4/7/97	9.29	7.80	130%
4/28/97	5.91	4.96	83%
5/19/97	5.88	4.94	82%
6/16/97	8.75	7.35	123%
7/11/97	8.46	7.11	118%
7/23/97	3.2	2.69	45%
8/8/97	4.85	4.07	68%
8/19/97	3.08	2.59	43%
9/5/97	4.13	3.47	58%
10/18/97	8.45	7.10	118%
11/14/97	3.68	3.09	52%
2/13/98	6.89	5.79	96%
3/20/98	4.77	4.01	67%
4/17/98	5.77	4.85	81%
4/29/98	3.20	2.69	45%
5/15/98	4.42	3.71	62%
5/27/98	3.24	2.72	45%
6/12/98	3.63	3.05	51%
6/26/98	5.76	4.84	81%
7/14/98	5.57	4.68	78%

In spite of these results, nowhere in the study is reference made to any plant stress or growth problems, much less a complete plant shutdown that would be expected for these types of soil moisture depletion levels in either sudangrass or alfalfa. In fact, yields are shown to be from 3.78% above the Imperial Valley farmers' average for sudangrass to 1% below the average for alfalfa.

9. Yield Impacts: From yield data provided in the paper, we see that study area yields for sudangrass exceeded average yields produced by Imperial Valley farmers in the first two years of the study; whereas, those for alfalfa exceeded those for the first year. Although, the last two years of alfalfa production were less than the valley average, as Dr. Bali indicates, the reduction in yield was less than 2%.

After Tables 10, p. 32 and 18-20, p. 38. Sudangrass yield (ton/ac), adjusted to 10% moisture

	Imperial Valley farmers		Study Area 70		Study -Valley Farmers	
Year	Area (ac)	Yield (ton/ac)	Area (ac)	Yield (ton/ac)	Yield (ton/ac)	Study-Farmers/Farmers
1995	77,365	6.50			--	--
1996	85,896	6.36	7.46	6.84	+0.48	+7.02%
1997	87,562	5.56	7.46	5.90	+0.34	+5.76%
1998	70,068	4.91	7.46	4.84	-0.07	-1.45%
Ave	80,223	5.83	7.46	5.86	+0.25	3.78%

After Tables 9, p. 32 and 21, p. 39. Alfalfa production (ton/ac), adjusted to 10% moisture

	Imperial Valley farmers		Study Area 70		Study -Valley Farmers	
Year	Area (ac)	Yield (ton/ac)	Area (ac)	Yield (ton/ac)	Yield (ton/ac)	Study-Farmers/Farmers
1995	182,401	7.88			--	--
1996	161,116	7.56	7.46	10.51	+2.95 ton/ac	28%
1997	165,922	7.56	7.46	6.59	-0.97 ton/ac	-15%
1998	178,517	7.65	7.46	6.62	-1.03 ton/ac	-16%
Ave	171,989	7.66	7.46	7.91	0.32	-1%

10. Water Table Contribution (WTC): With all of this, the conclusion of the study says that makeup water from the aquifer is only 11% to 18% (page 51). As can be seen from the table presented below, while the amount of water available to the crop over the entire season agrees with Dr. Bali's reporting, the water available to the crop root zone is not presented for the reader's consideration. Thus, concerns arise about plant stress and the real water table contribution.

From Dr. Bali's analysis we find that applied water for alfalfa was 149.28 inches, rain was 3.72 inches, and water table contribution was 17.57 inches -- around 11% (Table 22, p. 43 and Table 25, p 49). However, as can be seen from the table below, this calculation was based on the amount needed to meet crop ET (ETc). How it reaches the crop in a way to provide sufficient soil moisture to meet crop requirements is never indicated.

Therefore, as presented in this paper, Dr. Bali has not convinced the reader that the water table contribution was sufficient to meet the crop needs for available water without stress. Furthermore, as far as the reader can tell, ETc and WTC are dependent on each other, and Dr. Bali has not made clear how the value for either of them was obtained as an independent value.

D R A F T

After Table 22, p. 43. Alfalfa Irrigation – Water Table Contribution. Average crop coefficient ((AW+rain+water table contribution, WTC)/ETo) for the entire alfalfa growing season was 0.84.

Julian	Date	Rain since last irr (in)	WTC since last irr (in)		ETc since last irr (in)	Soil Moisture at time of irr	Alfalfa Irr (in)	Soil Moisture after irrigation (in)		Available Soil Moisture @ Stress
			.84 ETo -.75 ETo	Initial SM+ WTC +Rain				SM @ irr +irr		
	11/8/95						3.91	3.91	3.91	2.1
	12/4/95	0	0.23	4.14	2.10	2.04	3.53	5.57	5.57	2.1
22	1/22/96	0.04	0.33	5.93	3.06	2.88	5.01	7.89	6.00	2.1
78	3/19/96	0.12	0.69	6.81	6.43	0.38	5.52	5.90	5.90	2.1
114	4/24/96	0	0.85	6.75	7.95	-1.19	6.13	4.94	4.94	2.1
137	5/17/96	0	0.68	5.62	6.38	-0.76	5.62	4.87	4.87	2.1
158	6/7/96	0	0.64	5.51	6.01	-0.51	4.99	4.49	4.49	2.1
184	7/3/96	0	0.77	5.26	7.23	-1.97	5.57	3.60	3.60	2.1
214	8/2/96	0	0.83	4.43	7.75	-3.33	5.49	2.17	2.17	2.1
253	9/10/96	0	1.00	3.16	9.33	-6.17	5.28	-0.89	-0.89	2.1
305	11/1/96	0	0.97	0.08	9.03	-8.95	5.30	-3.65	-3.65	2.1
355	12/20/96	0	0.39	-3.26	3.68	-6.94	4.19	-2.75	-2.75	2.1
415	2/19/97	0.32	0.53	-1.89	4.96	-6.85	4.37	-2.48	-2.48	2.1
462	4/7/97	0.12	0.84	-1.52	7.80	-9.33	4.65	-4.68	-4.68	2.1
483	4/28/97	0	0.53	-4.15	4.96	-9.11	4.66	-4.45	-4.45	2.1
504	5/19/97	0	0.53	-3.92	4.94	-8.86	4.57	-4.29	-4.29	2.1
532	6/16/97	0	0.79	-3.50	7.35	-10.85	4.47	-6.38	-6.38	2.1
557	7/11/97	0	0.76	-5.62	7.11	-12.73	5.27	-7.46	-7.46	2.1
569	7/23/97	0	0.29	-7.17	2.69	-9.86	1.42	-8.44	-8.44	2.1
585	8/8/97	0	0.44	-8.00	4.07	-12.08	4.80	-7.28	-7.28	2.1
596	8/19/97	0	0.28	-7.00	2.59	-9.59	1.79	-7.80	-7.80	2.1
613	9/5/97	0	0.37	-7.42	3.47	-10.89	4.59	-6.30	-6.30	2.1
656	10/18/97	1.18	0.76	-4.36	7.10	-11.46	4.60	-6.86	-6.86	2.1
683	11/14/97	0.00	0.33	-6.53	3.09	-9.62	3.40	-6.22	-6.22	2.1
773	2/13/98	1.19	0.62	-4.41	5.79	-10.20	4.58	-5.62	-5.62	2.1
808	3/20/98	0.59	0.43	-4.60	4.01	-8.61	4.60	-4.01	-4.01	2.1
836	4/17/98	0.16	0.52	-3.33	4.85	-8.17	5.15	-3.02	-3.02	2.1
848	4/29/98	0	0.29	-2.73	2.69	-5.42	3.24	-2.18	-2.18	2.1
864	5/15/98	0	0.40	-1.78	3.71	-5.50	4.39	-1.11	-1.11	2.1
876	5/27/98	0	0.29	-0.82	2.72	-3.54	3.87	0.33	0.33	2.1
892	6/12/98	0	0.33	0.66	3.05	-2.39	4.70	2.31	2.31	2.1
906	6/26/98	0	0.52	2.83	4.84	-2.01	4.55	2.54	2.54	2.1
924	7/14/98	0	0.50	3.04	4.68	-1.64	5.07	3.43	3.43	2.1
		3.72	17.72				149.3			
				ETc	165.40	13.8	AF			
				Rain+WTC+Irr	170.72	14.2	AF			
				Runoff (2%)	2.9856					
				Available Water	167.74	14.0	AF			

When Dr. Bali indicates the amount of Water Table Contribution since the previous irrigation event, this particular concern may be alleviated. However, Dr. Bali will have to be sure to indicate very clearly how the determination of the WTC was made.

On the other hand, from the presentation in this paper it is by no means clear that, aside from evaporation, water applied during the preparation irrigation in November was not stored in the soil (raising the water table level) and used by the crop once its root system developed. If this were the case, the water table contribution would be about the same (around 5 inches) in both years. Then the reason for reduced yield in the second year of the study would be under-irrigation. Presenting the water table contribution and yield data more specifically, will address this (unlikely) possibility, as well.

What needs to be done:

1. Indicate how either ETc or WTC was obtained as an independent value.
2. Indicate how the WTC would have been taken up in such a way as not to stress the crop. As can be seen from the table presented in Point 10, the model of $WTC = (0.84ETc - 0.75 ETo)$ which must be inferred from the statement on page 44 that indicates: $(AW + Rain)/ETo = 0.75$ (w/o WTC) 0.84 (including WTC) is not adequate to convince the reader of the author's argument.
3. Present in graphic form the soil moisture water balance, so the reader can see how water is being supplied to the root zone and used by the crop during the irrigation season. Point 2 relates to the crop water requirement of soil moisture of 3.9 inches or more to keep crop stress to a minimum.
4. The Yield and WUE values for the two borders that received the extra irrigation in 1997 as compared with the borders that did not receive extra irrigation (8% increase in AW, 27% to 31% yield increase) need to be provided. Dr. Bali should also indicate impact on the average yield for alfalfa irrigated using his recommended regime for that year.

Other Research, Analysis and Presentation Issues

1. Given the absence of a scientific control, Dr. Bali should make very clear what "average values" were used (yield and water application) to determine the current WUE values against which the study results were compared. Consider the following:

On page 31, Dr. Bali states, "According to UCCE guidelines ... approximately 6.5 ac-ft/ac of water are used annually on alfalfa. ... Approximately ½ ac-ft-ac of water is used for land preparation and approximately another ½ ac-ft/ac is used for leaching." Actually the UCCE Guidelines, recommends a ½ AF flood irrigation for land preparation, and 2 irrigations of ½ AF each for crop establishment (Mayberry, 1996, p 7). In addition, Dr. Bali in his study reports applying about ½ AF flood irrigation for land preparation prior to irrigation for crop establishment. **What irrigations exactly are accounted for in the WUE calculations;** and what was done about these irrigations in this study; i.e., how much water was applied and how was it accounted for?

2. Page 27: The effect of reduced surface runoff irrigations on **alfalfa yield** was only minimal (less than 2% reduction); see also Page 32, Table 9 and Table 10, and Page 51: Effect on alfalfa yield was only minimal (less than 2%) reduction. Please specify whether this is for dry yield or at 10% moisture. Also, give values for expected yield data and source.

Typically, farmers make 8 to 9 cuttings/year. In study, there were 8 cuttings the first year and 7 cuttings the next two years. If an extra irrigation were applied for each of these extra cuttings, the water application would be increased – the impact on the WUE in such a scenario is not known.

3. **Runoff reduction** implies that runoff was reduced from some percentage to some other percentage. So in the study runoff was reduced to 2% -- **this should be compared to what** value when considering the irrigation recommendations presented in the UCCE Guidelines?

Specific Questions:

1. Page 30: “Except for a few occasions when the IID canal water ran dry during an irrigation event, we had complete control of when to turn the water on or off to (sic) the field.” Explained what happened. Why was an irrigation event scheduled during a period when the water supply would be out?

2. Page 37: Cutoff distance guideline – do application flow rate and/or field slope impact the cutoff guideline?

ALFALFA, pages 44 to 49

1. Page 46: Please specify how much of the field is represented by the lower end in, “... almost the entire alfalfa yield at the lower end of the field is commonly lost to scalding.”

2. What are typical yields for alfalfa at UCDREC?

3. What happened in 1997 and 1998 to reduce yield to 6 ton/ac from the 10 ton/ac in 1996?

4. Did hay quality vary for these years? Only hay quality information provided is for 1997.

5. Please provide yield and WUE values for the two borders that received the extra irrigation in 1997 as compared with the borders that did not receive extra irrigation (8% increase in AW, 27% to 31% yield increase); also make clear the effect on the overall average

6. Please provide ET_c values for alfalfa for the years of the study, and compare water available to the crop with the ET_c

7. Explain the source of water from the water table, from what depth does it come, in what amounts, etc.

8. Page 48, to assist the reader, provide a brief description of the mass flow method (Wallender et al. 1979) used to estimate water table contribution – either in the paper or as an appendix

9. Page 49, what was the date of the leaching irrigation and how much water was applied

10. Please provide specific dates for data described in the top paragraph and in Table 25

11. Page 49, notes that “greater upward water movement occurred at the lower end of the field as compared to the upper end of the field.” How is it known that the “leaching” was not movement of water to the presumable lower end of the field?
12. Explain what caused the water table contribution to be so greatly reduced after the first year
13. Re Fig. 49, p 71 and comments pages 47 and 48: Explain the mechanism which caused the water table to decrease so much in 1996, less in 1997 and hardly at all in 1998
14. Fig 50, invert scale to match Figs. 46 through 49
15. As an adjunct to Figs 46-49 and in the same layout, provide a Fig. showing the average root depth throughout the growing season
16. Fig. 49: Explain what caused the water table to increase more than 20 inches from Day 600 to Day 650, or so
17. Explain why there was hardly any decrease in the water table from after Day 650, or so, to the end of the experiment
18. Fig 43 & Fig 44. What was done to reduce the Soil Salinity profiles from those shown in Fig. 43 (alfalfa) to those shown in Fig 44 (corn)?
19. In Table 22, page 43, for each irrigation event, provide Julian days as well as Gregorian days .
20. Page 51: Alfalfa crop coefficient 0.84; Sudan grass crop coefficient of 0.81 -- what is typical in the Valley for each?
21. To assist the reader/user, provide a brief description of the Grismer and Tod method (1994) to estimate volume of cracks and cutoff distance or time.

CORN

1. Page 46: What kind of corn was grown? How was it irrigated – using the reduced runoff technique? What was the yield/ac? What was the quality?
2. Please describe the leaching irrigation and amount applied prior to planting sweet corn. How and where do we account for this irrigation in the Water Use Efficiency calculations?

Editorial Comments:

1. Throughout document, style where a numerical range is indicated as “2.8-3.0 million acre-feet” can be confusing, not clear at times if the hyphen is being used as a hyphen or a minus sign. Therefore, where it is meant to indicate 2.8 to 3.0 million acre-feet, use the preposition “to” or in some cases “through” instead of the hyphen/minus sign.
2. Use cut-off or cutoff, choose one style then check throughout for consistency
3. Flow rate is two words in English, Figs. 2-13
4. Paragraph 1: “... an (sic) recently agreed upon allotment of 3.1 MAF of Colorado River water...” The agreement is not finalized, revise this statement
5. Provide Fig. and Table to summarize data included in the Executive Summary
6. Page 2, last paragraph, Line 4: “The effect of reduced surface runoff irrigations...” What is a surface runoff irrigation?

Field 1	Sudangrass		April 1996	April 1997	April 1998	
Field 2	Alfalfa	Nov 95	1996	1997	July 1998	
Fields 1 & 2	Corn					Feb 1999

	Sudangrass (tons/AF/ac)	Alfalfa (tons/AF/ac)
Test AWUE	1.77	1.76
Test WUE	1.75	1.54
CA AWUE		1.80
AZ AWUE		1.49
Imperial Valley AWUE		1.17

7. Please provide the missing data, also tables like the above would assist the reader of the Executive Summary.
8. Page 3, “We found that shutting off...” line 3, reducing runoff to only 1-6% -- begs the question, reducing from what base?
9. Page 3, “Water table contribution (WTC) ...”, what is the WTC to sudangrass?
10. Page 4, paragraph 1, line 2: change to read: “... improve **on-farm** irrigation efficiency”
11. Page 4, Use of CIMIS reference ET data for irrigation scheduling was not clearly presented in this report
12. Page 6, paragraph 1: ... salinity of the Sea is over 47,000 ... This statistic is not relevant to the study, unless you mean to show that reducing runoff would increase the salinity of the Sea. If that is your intention, please add the comment
13. Page 6, paragraph 3: “This research and demonstration project was conducted at UCDREC to verify the effectiveness of this method...” To verify what method? The Tod-Grismer procedure, or what? Not clear from this sentence.
14. Page 6. Objective: “The objective of this **Handbook** ...” Handbook was not mentioned in the paper title.

15. Page 6: "Irrigation **scheduling** can be based on a relatively simple technique that predicts the cut-off time ..." One would use CIMIS to schedule an irrigation, i.e., to determine when to irrigate. It would be better to state, "The cut-off time can be determined using a relatively simple technique."
16. Page 7, first 2 lines: "... the total volume of water applied equals the volume stored on the surface plus that below (subsurface storage)." -- **when there is no runoff**
17. Page 7, paragraph 2: "... volume of applied water can be estimated from **onflow** (sic) rate ..." Onflow is not a word in the English language. Replace with "flow rate" wherever it occurs in this report.
18. Page 7, paragraph 2: "Figure 1 schematically illustrates this concept" – the Tod-Grismer concept, or what?
19. Page 7, Fig 1. Provide a title, What is being illustrated in this figure is NOT CLEAR
20. Page 21: USDA **Soil** (sic) Conservation Service (NRCS). Replace "Soil" with Natural Resources
21. Page 22: Advance ration (ft/min) – is this the advance rate?
22. Page 24: Field Characteristics: Crop & maturity -- does this mean Surface roughness? Since a range of values is provided for this parameter, it would be best to use this term
23. Flow rate (cfs) Q – "These measurements are taken when the surface wetting front has advanced ¼ to 1/3 of the border length down the field – how is the user of this material to make this measurement?
24. Page 27: See comments for pages 2 and 3
25. Page 31: focus of this work – Reduce the frequency of application to utilize the shallow ground water (alfalfa fields). This was not evident in the Executive Summary presentation
26. Please provide list of abbreviations